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A Methodology to Assess Safety Conditions in Louisiana Agriscience Laboratories.

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A METHODOLOGY TO ASSESS SAFETY CONDITIONS IN LOUISIANA AGRISCIENCE LABORATORIES

A Dissertation

Submitted to the Graduate Faculty of the
Louisiana State University and
Agricultural and Mechanical College
in partial fulfillment of the
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in

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by
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ABSTRACT

The safety conditions of the agriscience laboratories of the high schools of the State of Louisiana have not been studied extensively. This study was undertaken to develop a methodology to assess these conditions.

The Southeastern region of the state was selected as the research area. Forty four high schools in this area have agriscience laboratories. Forty one of these laboratories were assessed.

A Hypothesized Survey Model was made up from the background information searched. This model was validated at another school region and used to design a Research Survey Model. This RSM was face and field validated.

Safety ratings were obtained at the individual schools for the items assessed. General ratings for the school laboratory system were also obtained.

The items assessed were evaluated for safety importance by six campus safety experts. A factor to accrue for this evaluation was calculated and applied to the ratings of all items assessed in order to obtain balanced numerical values. This values represent both the condition and importance of the items assessed.

Most common safety problems were identified, and recommendations were made to improve laboratory safety conditions.

The proposed methodology to assess safety conditions was tested and recommended for other environments in the work place.

The instrument used being field validated was also improved thereafter. As a result of this research, the improved instrument has been strongly recommended for future assessments on the agriscience laboratories.

CHAPTER 1

INTRODUCTION

Industrial technology is continuously producing changes in materials, tools, equipment, machinery, methodologies, services, developments, etc., that are then made available in the marketplace. Automation, increased production, scientific engineering, and changing occupational needs are indicators of dynamic technological progress.

In order to meet the needs of this continuous evolution of industry, school curricula have expanded to include more occupational and technical subjects. The growth and expansion of the curriculum in the public schools have created problems which have aggravated the complexity of teaching. One of these problems involves the number and character of the activities currently included in the curriculum of a modern high school. Laboratory courses are designed to help students understand and judge the effects of the basic elements involved in a technological culture. The use of tools and machinery which are relatively hazardous to operate has accompanied the growth and expansion of the curriculum.

Agriscience education is an integral part of the program of education and provides some unique opportunities for students to participate in representative experiences in different skills and processes. All students, regardless of their technical or academic goals, benefit from these experiences, which also help them discover and develop personal aptitudes, interests, creative technical abilities, self

reliance, sound judgment, and resourcefulness through problem solving and self expression in an environment related to industry or else to domestic activities.

The expanded and more comprehensive offerings in the public school system of education have required a greater participation of students in the laboratories, thus increasing the potential for situations that contribute to accidents. The responsibilities of the teachers have been increased significantly, beyond their regular teaching duties.

Concern for the immediate welfare of students is expected from teachers. This is essential because students themselves do not always use the best judgement, often lacking the experience and maturity necessary to make competent decisions. Positive action by teachers is necessary. A teacher, therefore, must be better prepared and more aware of these responsibilities to the students and the community than ever before (Kigin, 1983).

Ascertaining a safer learning environment for students enrolled in agriscience laboratories in the State of Louisiana is one of the purposes of this research. The agriscience laboratories need to be as accident-free as possible. Students should have the right to be trained and educated in an accident free environment, and also because as high school students are trained and educated in sound safety practices, they will be more safety conscious when they eventually join the work force.

According to Kigin (1983), the place where a student engages in shop activity must be conducive to modern learning and the responsibility for providing

a suitable place is shared by the school district and the teacher. The school district is required to provide adequate facilities and the teacher is expected to utilize them in a safe and proper manner. Interpreting the previous statements, the institutional organization or the school district is responsible for providing a suitable or adequate place, facility or laboratory, and the teacher is responsible for its safe operation. The safe operation component is what this research is going to ascertain.

Southeastern Louisiana was selected as the research area for this study due to its diversified cross-section of activities that range from the larger cities to the smallest towns, from the industrialized areas and port activities to recreational developments and rural communities, from sugarcane areas to pasture lands, from woodlands to wetlands, from shipyards to fisheries and coastal areas, and also has a wide spectrum of cultural, educational, demographic and ethnic influences. For this reason, the research population of Southeastern Louisiana was representative of the diverse environments that affect the safety of the agriscience laboratory.

The research questions were:

a. Can a validated and improved methodology to assess the safety conditions of the Southeastern Louisiana agriscience laboratories be utilized for future research or in the course of future assessments of the safety conditions of these laboratories?

b. Were there any unsafe conditions in the agriscience laboratories of Southeastern Louisiana, according to the methodology developed in this research?

c. If so, what were they, and how could they be improved?

1.1 The Learning Environment.

The subject of this research was the agriscience laboratory, which together with its interacting environments is the learning environment. The agriscience laboratory, or the physical environment is the laboratory facility itself and the materials, tools, equipment and enclosed installations, including their characteristics and limitations. The safety conditions of the agriscience laboratories of the research area will be assessed and examined to determine their status or degree of freedom from accidents for the students enrolled. This physical environment interacts with the following two environments.

a. The institutional environment, which includes the Department of Education; the school district; the school board; the school principal and the teacher; and the federal, state, local and school regulations, all of which in turn are also referred to as the administration or management.

b. The community environment, which is the direct beneficiary of the programs. It includes the students, parents, student and parent organizations, other citizens and groups interested in their schools,

and also students' educational influences, attitudes, and cultural background.

Figure 1.1 illustrates how these different environments, the institutional environment, the community environment, interact with the agriscience laboratory, all that constitute the learning environment.

1.2 Research Objectives.

In a continuum from the research questions previously raised, the specific objectives of this research were:

a. To develop a methodology to assess the safety conditions of the facilities, materials, equipment and instructional safety methods used in agriscience laboratories in Southeastern Louisiana.

b. To validate and improve the above methodology, as it was developed, by interviewing teachers and evaluating data collected from the Southeastern Louisiana agriscience laboratories through the use of this tool.

c. To identify the most common safety problems in agriscience laboratories, if any, as the above methodology was developed and validated, and suggest most appropriate solutions or means for improvements.

d. To make recommendations about the best use of a validated and improved methodology, for future research and safety assessments.

THE LEARNING ENVIRONMENT

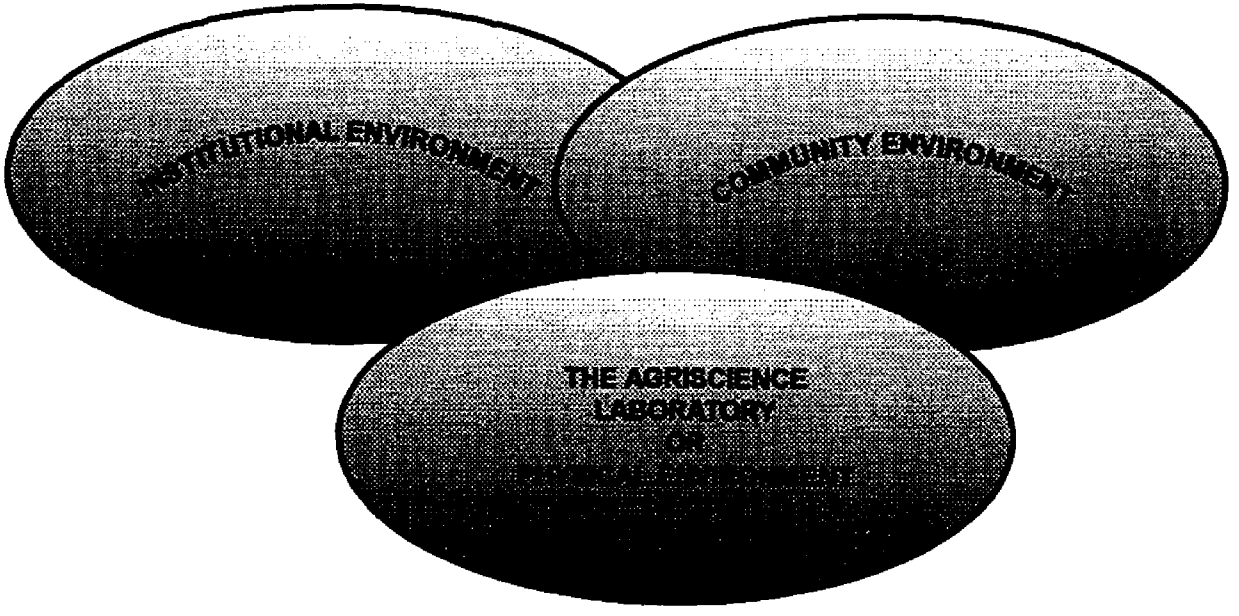

Fig. 1.1 The Agriscience Laboratory or Physical Environment interacting with the Institutional and the Community Environments

To achieve these objectives a methodology was designed to assess the safety conditions of these laboratories and this methodology was field validated, evaluated and improved. Through field validations and improvement of the methodology, recommendations could then be made for its use in future research and assessments, and, the present safety conditions of the agriscience laboratories could be determined. Conclusions and recommendations will be made to improve safety at the assessed facilities.

CHAPTER 2

BACKGROUND AND RELATED RESEARCH

2.1 General Aspects

The hazardous agriscience laboratory has been the concern of some researchers. Lawyer (1992) presented a paper titled "An Analysis of Agricultural Mechanics Safety Practices in Texas Agricultural Science Programs" at the Nineteenth Annual National Agricultural Education Research Meeting, in St. Louis, Missouri. According to Lawyer, agricultural laboratories found in secondary agricultural science programs are potentially hazardous. These laboratories include agricultural mechanics laboratories, and others, where students are exposed to metal working, wood working, agricultural machinery, electricity, chemicals and other potential hazards.

Johnson & Fletcher (1990) in their paper titled "An Analysis of the Agricultural Mechanics Safety Practices of Mississippi Secondary Agriculture Teachers" presented at the Thirty-Ninth Annual Southern Agricultural Education Research Conference in San Antonio, Texas, stated that students in agricultural mechanics learn in an environment fraught with potential hazards, and that several studies have documented unsafe conditions which existed in the nation's agricultural mechanics laboratories (Brown, 1977; Lamb, 1984; Rudolph & Dillon, 1984; Gliem & Hard, 1988; & Burke, 1989).

In general, students enrolled in agriscience laboratories use tools and equipment. The very nature of the curriculum requires relatively inexperienced

teenage students to interact with tools, equipment, supplies, and situations which present real potential for serious injury or even death, (Johnson & Fletcher, 1990).

Vocational educators, through their special knowledge, can make a unique contribution to the various elements of a comprehensive occupational safety and health program. In addition, they can readily translate this information into the education and training of young men and women to work safely and successfully in today's technological society (Godbey, 1979). Furthermore, the idea that workers must be educated to do their job safely, and such education must start at the high school level is expressed by Godbey (1979) as follows: "The importance of this training was aptly expressed by Dr. Eula Bingham, Assistant Secretary for Labor, in a recent interview ...it is very important to start educating workers when they're still in the training stage. For example, in high schools where individuals are learning vocational skills, they must learn how to do the job safely. We must start even earlier than that in terms of changing attitudes. I believe that every child should grow up to adulthood expecting to have a safe and healthful workplace.... We have to change attitudes so that people expect as their right, a safe and healthful workplace. That's the ultimate goal."

The literature reviewed regarding accident prevention can be organized around the concept of the learning environment, that has been developed in the introductory part of this research, with its three components: the community, the institutional, and the physical environments.

2.2 The Community Environment

Students and their educational programs and goals are all integral parts of a community or society. The community in consequence should guard the well-being of students, and, ensure that they are provided among other things with an accident-free environment, where they need to be involved.

"Because the public pays the cost of operating public schools, it is entitled to know how well the schools are educating its children. Given the knowledge that the job is being done, that expenditures of tax money are, in fact, purchasing quality education, the public will usually support any worthwhile program that a school proposes (Brown, 1979). Also according to Brown, schools must do everything in their power to keep the residents of a district fully informed as to the needs of their schools and the educational progress being made. Special efforts must be made to reach public officials, news media, parents, taxpayers' organizations, fraternal organizations, and civic, religious, business, industrial, labor, and professional groups, all of which are important sources of support for education.

The agriscience programs need the support of these groups, as well as of the school administrative officers. Because the cost per student of agriscience classes are much higher than those of most other subject matter areas, they need to be carefully justified. The existence of a well equipped laboratory does not signify that the program has universal acceptance in the community.

Referring to the convenience of a well informed citizenry, Elkow (1970) had the following remark: "Essential to the attainment of improved safety for any community is an informed citizenry including parents and workers, youths and adults. Developing attitudes, skills, and knowledge about safety will be the school's responsibility, assisted by many capable out of school individuals and agencies who will contribute their expertise. It is generally accepted that any community can provide the amount of safety it desires. It will take dedication on the part of many community leaders to inform, motivate, and secure support, for a better safety effort in the local, national, and world communities.

Also, knowledge of the impact of automation on society, the decentralization of industry, the development of economic interdependence, the fundamental principles of industrial processes, and the utilization of human resources are desirable if today's citizens are to function intelligently (Industrial Arts Education, 1963).

Safety Attitudes. In dealing with high school students, it is convenient to consider the attitudes that they may have toward safety. The concepts behavior and safety are commonly mentioned in the literature, and because of the age and nature of high school students, these two concepts become very significant.

Woods (1970), expressed that more and more educators are beginning to realize that in order for a student to learn to his fullest potential, he must be given an environment that is, both, psychologically and physically safe. He must be allowed to discover for himself, through in-depth experiences, the behavior that

will bring him the greatest good. Woods also stated that safe behavior is a direct result of psychological safety, which means feeling safe in your mind before you make a move to do anything.

According to Anton (1979), safety is not a state of mind. It is a batch of behaviors which usually differ widely in different settings. Apathy for safety is a frequently encountered situation. Elkow (1979), indicated that in the continuum between apathy and ardor for safety, lie numerous opportunities for a man, to demonstrate that he is a rational person capable of making the right decisions, in the presence of certain hazards. With understanding apathy diminishes. Increasing the understanding of the hazards ever present in an advance technological society and increasing the knowledge about safety, will encourage the development of a safer society. Attitudes should be developed that will encourage students to work safely in the school shop. Attitudes of personal responsibility should be nurtured throughout every shop course.

According to Science: A Guide to Curriculum Development a positive attitude toward skill development is prerequisite of the safety of an individual. The teacher is responsible for promoting desirable attitudes that assist students in developing a proper respect for safety. Success in the utilization of mechanical aids and safety devices depends on the development of desirable attitudes and proper skills. There is a high correlation between faulty attitudes, and, lack of knowledge. Although it may not always be possible to isolate a particular faulty attitude, every possibility should be considered in a honest attempt to identify

those traits that tend to increase the vulnerability of the students to accidents. Efforts can, then, be directed toward helping the students recognize a dangerous situation when it occurs, and take the proper precautions.

Feeling endowed with a degree of immunity from accidents is very common, and such feeling is a dangerous attitude. Many accidents occur in the school shop as a result of a lack of knowledge, a lack of alertness, or preoccupation with other matters. Contributing factors in accidents are anxiety and emotional instability, which cause the student to deviate from normal behavior. The teenage student can be helped materially, by creating an awareness of the seriousness of a situation which may develop when his alertness is reduced, or, when he is careless.

Accident Proneness. The accident proneness of students has been a concern of some specialists and investigators. Saving Children: A Guide to Injury Prevention (1991) refers to this concept as follows: "Within groups of the same age, sex, geographical locale, and socioeconomic status, investigators have long been interested in predicting which individuals are most likely to be injured because of some innate characteristic, that is, those who are accident prone. Many observers of children believe in the concept of accident-proneness, but it has not been confirmed by careful research (Langley, 1982)."

From Grimaldi and Simonds (1989) the following is quoted: "If a person does experience repeated accidents, the causes may be any one of a number of inherent conditions related to the person's physical or mental makeup or the

environment in which he works. Every effort must be made to seek out these causes and prevent them from being overlooked. Age would seem to have some relationship to accident experience. Schulzinger, Accident Proneness, reported a declining accident rate, for the groups of persons studied, as the age-group years increased. This supports earlier studies summarized by Tiffin and is probably the result of the increase in experience accompanying growing older plus a probable decrease in irresponsibility, impulsiveness, and daring."

King (1964) Age Analysis of Some Agricultural Accidents, in a study of age-injury relationships, found that the nature of the injuries (type), their causes, and the parts of the body affected all differ with age. This led him to suggest that perhaps there should be some differentiation in the injury prevention efforts as applied to younger and older people.

From all of the above, a possible relationship exists between accident experience and age. In conducting this research consideration will be given to the age and nature of the high school students, which are intended to be given an accident free learning environment.

2.3 Institutional Environment

According to Dyrenfurth & Linhardt (1981), science safety should be the concern of teachers, administrators, staff members, supervisors and students. The development of a formal program of safety practices and procedures should include training for teachers and administrators. The training of all teachers of science in appropriate safety procedures, and, the use of laboratory equipment

should be a high priority for any school. As previously expressed, the safety of the students in the agriscience laboratories rest on the teachers, the supervisors and administrators of the school system.

The concern of some educators and researchers for the safety of students in agriscience laboratories, has been expressed in several occasions. Godbey (1979) expressed the earlier roll of vocational educators as follows: "From the beginning of vocational programs in schools, vocational educators have been concerned for the safety of their students and fellow employees. More recently, a great deal of interest has also been focused on the potential health problems in their shops and laboratories".

Johnson and Fletcher also mentioned educators (Cook, Walker, and Snowden, 1952) and (Bear and Hoerner, 1986) as recognizing the dangers inherent in the agricultural mechanics instruction setting and stressing the importance of safety. Gliem and Miller (1990) stressed the importance of safety in the classroom and laboratory when they made reference to the responsibility of the school administrators regarding an accident free environment for students. They quoted Williams (1975) as follows: "When public school administrators first undertook the obligation of providing shop and laboratory experiences for youth and adults enrolled in their schools, they assumed a responsibility to provide an accident-free environment and a program of instruction which would include emphasis on effective safety practices."

In reference to the responsibilities of the teacher, Science. A Guide to Curriculum Development (1991) says that the science teacher's responsibilities begin with a duty to offer proper instruction for students, and that, in a laboratory situation, this requires careful attention to the use of safe methods and materials. Proper procedures for the handling of supplies and equipment should be taught in a planned, formal lesson, and, reinforced as laboratory activities are conducted. Safety should be the concern of everyone; teachers, administrators, staff members, supervisors and students. The development of a formal program of safety practices and procedures should include training for teachers and administrators.

According to the same publication, a shop teacher is duly responsible for the exercise of safe practices in his own classroom, and, accepts the protection of students from accidental injury as one the his major responsibilities. A mature, well trained, safety conscious teacher is essential. Safety consist of more than just dispensing information or developing a set of rules and regulations. Effective instruction involves teaching students the right form of behavior, in addition to motivating them in the development of acceptable operational skills. If a teacher could be so well informed as to be able to enforce a set of perfect safety practices, he could be freed from responsibility for negligent acts and the resultant liability. However, there is no magic formula available, and, no clear-cut rules that will guarantee complete freedom from liability.

It is evident, therefore, that one of the most important responsibilities of an agriscience instructor is to ensure the safety and the physical welfare of the students, and that he must be more aware of this responsibilities to the students and the community than ever before. On the other hand, sometimes teachers alone do not carry all the responsibility, because of their dependency of school officials. Bear (1980) and McMahon (1975), made reference to this subject when they expressed that although teachers have the primary responsibility for ensuring the safety of vocational students, teachers have difficulty meeting this responsibility without the support of school administrators.

But also engineers share the responsibility for the safety of the students, as Kavianian and Wentz (1990) stated that although engineers and managers can minimize the risk of being sued, they cannot avoid their professional responsibility, to protect human health and the environment with their expertise and knowledge.

Furthermore, Godbey (1979) and La Morte (1990), expressed their concern by saying that many schools no longer have sovereign immunity, and may be held liable for accidents in negligence suits. Connors (1981), also expressed the following: "We do live in a litigious society, and educators as public servants are increasingly frequent targets of litigation. It is increasingly important for educators to properly maintain equipment, provide instruction in safety, and adequately supervise students engaged in laboratory activities."

School teachers, supervisors and administrators could be referred to as the managers of the agriscience laboratory environment. The concept of management have been considered by some researchers and investigators.

Burke (1986), discussed several practices associated with efficient laboratory management and listed the regulation of environmental factors, storage of tools, and control of consumable supplies as areas which are important for efficient management of the agriscience laboratory.

Industrial Arts Education (1963), published by the American Council of Industrial Arts Education, establishes that the organization of the industrial arts shop in grades seven through twelve is a responsibility of the teacher, working cooperatively with the school administration; and also establishes the requirements of the instructional program as follows:

a. The systematic layout of the physical plant for effective instruction.

b. Selection and purchase of equipment.

c. The development of instructional procedures.

d. The issuance and control of tools and supplies.

e. The maintenance of shop records.

f. The operation of an adequate safety program, and

g. The use of a personnel system based upon student participation.

Kavianian and Wentz (1990), made reference to the book Managing by Harold Geneen, former president and board chairman of ITT, to emphasize that occupational safety and health can be managed like any other aspect of industry.

Indeed, since the passage of OSHA, management has been held responsible for safety and health by government regulators as well as by others in the community.

According to Geneen there are three fundamental reasons to undertake safety programs:

1. Moral: Accident prevention is undertaken to prevent injury to personnel purely as the result of humane considerations.
2. Legal: Federal, state, and municipal requirements must be observed or penalties may be assessed for noncompliance.
3. Economic: Consideration is given to those monetary losses which could result from injury to personnel and, in addition, from property damage, destruction of material, interruption of operations, and other factors.

The first of these reasons is the one that applies to agriscience laboratories since the safety of the students, per se, is the ultimate goal. In reference to the second reason, Godbey (1979) expressed that although recent federal and state legislation in the occupational safety and health area does not generally recognize students per se, as employees and, therefore, does not provide direct protection, the application of these requirements to the school program will ultimately and effectively benefit the students.

Safety committees can be an excellent tool in promoting safety. Dyrenfurth & Linhardt (1981) remarked that while training in safety can be the beginning of a personal commitment to safe practices, the formation of a school safety

committee should be the beginning of a school wide focus on safety needs. Composed of representatives of administration, students, and the teaching and support staffs, the committee should be responsible for regular examinations of laboratory and storage facilities to assure that these facilities meet established safety guidelines. The committee should develop a plan for teaching safety, for evaluating procedures followed in laboratory activities, and for communicating top appropriate authorities the need for new or improved facilities, equipment and procedures.

2.4 The Physical Environment.

Johnson & Fletcher (1990) found that agriculture teachers in Mississippi were not using recommended safety practices or providing student safety and emergency equipment to the extent warranted by the hazards present in the laboratory, and that it was apparent that unsafe conditions existed in many Mississippi secondary agricultural mechanics laboratories. They also made reference to Brown (1977) which conducted systematic safety inspections of 19 Mississippi secondary agricultural mechanics laboratories. Brown had reported an average of 26 safety violations per laboratory. Common safety hazards included unguarded power equipment, inadequate hazardous materials (paint, fuel, etc.) storage, lack of student protective equipment, and poor laboratory organization and housekeeping. Brown concluded that many of the safety hazards could be corrected with little or no expense to the school district.

Furthermore, Johnson & Fletcher (1990), made reference to Kigin (1983), summarizing the status of safety in vocational education laboratories when he stated: "We stand in awe of the progress that has been made in industry to make the manufacturing process safe for workers, and then with chagrin realize that not enough has been done in the schools. Violations of safe work practices are still quite evident, with hazards being ignored and emergency equipment inadequate." They also mentioned Burke (1989), who had studied accident frequency in Virginia agricultural mechanics programs and concluded that, at five student accidents per teacher per year, the accident rate was excessive. Burke recommended that safety instruction should be enhanced, and that "further study should be made of the methodology currently used by teachers of agriculture to teach safety."

Lawver (1992), found that Texas secondary agricultural science teachers were using recommended safety practices and were providing student safety and emergency equipment but not in relation to the hazards present in the agricultural mechanics laboratory. The findings of Johnson & Fletcher and of Lawver were both consistent with the results of similar studies in Missouri (Lamb, 1984), Nebraska (Rudolph and Dillon, 1984), Ohio (Gliem and Hard, 1988), and Iowa (Hoerner and Kessler, 1989).

Both studies, Johnson and Fletcher's and Lawver's, concluded that based on the results of their studies, it was apparent that unsafe conditions existed in many secondary agricultural mechanics laboratories, and that safety program

improvement must become a top priority for agricultural educators in their respective states.

Lawver made the following recommendations based on the findings of his study:

1. Teacher educators and state supervisors should emphasize agricultural mechanics safety during local program visits. Recommendations for safety program improvements should be made and progress should be monitored.
2. In-service programs on agricultural mechanics safety should be planned and conducted. The programs should focus on how to plan, and implement comprehensive agricultural mechanics safety programs.
3. Pre-service agricultural education programs in Texas should be examined to determine if additional emphasis should be placed on safety in agricultural mechanics.
4. Funds should be made available for use in purchasing safety and emergency equipment items.
5. Research should be conducted to determine factors which prevent teachers from using recommended safety practices in agricultural mechanics.
6. Research should be conducted to assess the levels of safety compliance in Texas agricultural mechanics laboratories.

The recent work of Gliem & Miller (1993), recognizes the importance of safety, and mentions that several states, Dyrenfurth, et. al. (1981), Graham, (1981), Kirk, (1988), South Carolina State Department of Education, (1981); have published guides or handbooks on safety in occupational laboratories, and also mentions that agricultural education researchers Bruening, Hoover & Radhakrishna (1991), and Fletcher & Johnson (1990) have surveyed agricultural mechanics teachers to determine the extent to which selected safety practices were utilized and to determine the availability of selected safety materials and equipment.

Gliem & Miller, in reference to vocational educators, concluded that: "According to school administrators, vocational teachers use many of the safety practices espoused in the literature on laboratory safety. Most encouraging is the fact that all administrators reported that vocational teachers instruct students in how to properly use equipment, but there remains room for improvement on other teacher safety practices. Although some teacher safety practices may seem less important than others, each contributes to the overall safety of the vocational laboratory. The nonexistence of several safety materials and/or equipment in many vocational laboratories is discouraging. For example, approximately 12% of the administrators reported that first aid kits were not available in vocational laboratories. Additionally, many inexpensive safety materials (color coded power tools, safety zones around power tools, and safety cans for flammable liquids) were not available in some schools. Other materials and/or equipment (safety

guards on equipment, welding exhaust systems, and safety cabinets for explosive materials) were not available in some schools. The administrator's attitude toward safety was significantly related to both the number of safety materials and equipment available and the number of teacher safety practices utilized. Vocational education laboratories are relatively safe when one considers the nature of the laboratory environment. On average, administrators reported less than one vocational laboratory accident per year that resulted in student injury. On the other hand, vocational accidents accounted for more than 20% of the total number school accidents which is considerable more than the nine percent estimate made by Ramp et. al. (1975)."

And then they recommended that: "Teacher educators should make certain that pre-service teachers appreciate the importance of each practice, and develop ongoing strategies for reinforcing the use of these safety practices by practicing teachers. Although some of the materials and/or equipment are expensive, their potential contributions to the overall safety of a given vocational laboratory should not be ignored. Administrators should be encouraged to place higher priority on the acquisition and subsequent maintenance of safety materials and equipment for vocational education laboratories.

Unsafe conditions. The U.S. Department of Labor "Accident Investigation" (1987) give the following examples of unsafe conditions:

- Inadequate supports or guards
- Defective tools, equipment, or supplies

- Congestion of the workplace
- Inadequate warning systems
- Fire and explosion hazards
- Poor housekeeping
- Hazardous atmospheric conditions (gases, dust, fumes, vapors)
- Excessive noise
- Poor illumination
- Poor ventilation
- Radiation exposure."

Similar examples are listed by Laboratory Safety (1991). According to Elkow (1979) housekeeping should be ranked at the top of the list of things to be done to prevent accidents. It can be said that housekeeping is the one activity which, more than any other, is the spearhead of a safety program.

Many of the OSHA standards in 29 CFR Part 1910 are designed to eliminate a number of these conditions. The standards relate to almost every hazardous condition that may be found in a laboratory.

Shop Safety Rules. Because of its importance for this research, the rules that The American Institute of Chemical Engineers (AIChE), Guidelines for Hazard Evaluation Procedures, recommend for shop safety, are hereby listed:

- Use of tools and equipment only for their intended purpose.
- Return all hand tools to their proper place after use.
- Keep assigned areas clean and free of safety hazards.

- Operate any presses or electricity powered equipment only after the approval of an instructor.
- Clean up any spilled liquid immediately from floors, shelves, or tables.
- Do not sit or lean on light tables.
- Limit the operation of the paper cutter, paper drill, and stitcher to one person at a time.
- Limit the operation of all presses and duplicators to one person at a time.
- Tie back all long hair prior to operating any press or power equipment.
- Roll or tightly secure long sleeves and any loose garments prior to operating presses or power equipment.
- Do not clean any press or power equipment while in operation.
- Keep all aisles, doorways and areas around machines and equipment clean and clear of debris, paper, and boxes.
- Report any unsafe condition in the shop immediately.
- Do not get involved in any horse playing in shop or classroom area.
- Remove all metal jewelry when operating rotating equipment.
- Use soap and water frequently to help prevent skin irritation.
- Avoid touching and looking directly at light sources.

And they further give the following recommendations to maintain a safe and orderly shop:

- Arrange all machinery and equipment to permit safe and efficient operation.
- Keep materials and supplies safely stacked and stored.
- Keep all tools and accessories in cabinets or tool racks.
- Dispose of or store all combustible materials in safe containers.
- Keep all floors clean and free of debris at all times.
- Check that adequate housekeeping equipment and cleaning materials are on hand to insure that maximum cleaning efficiency can be maintained.
- Participate in daily cleanup periods.

2.5 Accident Prevention

Providing a safe, or, accident free environment for students requires an understanding of some basic safety concepts. In the literature reviewed, according to Saving Children: A Guide to Injury Prevention, learning to foresee accidents is the first step in preventing them, and according to Brown, the basic concept in prevention is to discover the causative factors and remove them.

In reference to the workplace (Anton, 1979) expressed that successful accident prevention programs depend on three essentials, which translated into the agriscience learning environment are:

1. Leadership by the teacher.

2. Safe and healthful working conditions.

3. Safe drill practices by students.

If any of these three essentials is missing, accidents on the laboratory are likely to occur.

In lieu of accident prevention for the agriscience laboratory, the concepts expressed in the U.S. Department of Labor, "Accident Investigation", would be translated for the agriscience learning environment as follows: Some of the more obvious preventive measures involve the identification and elimination of unsafe acts and conditions, but they are just part a of a series of steps needed to establish a meaningful accident prevention program. The most common safety approach is to establish a safety policy: carefully training supervisors and teachers; periodically reviewing all procedures; instituting inspection procedures; and correcting deficiencies. However, accident prevention actually should be addressed on three levels:

a. Highest level, an attempt must be made to determine the basic causes of each accident, by conducting special surveys* to assess:

- The hazards that exist.
- The procedures used to conduct each task, and
- Incidents and accidents that occur.

*These surveys are used to establish a meaningful safety policy, create safety awareness, and determine the personal and environmental factors that require attention.

b. Second level, an attempt must be made to eliminate unsafe acts and conditions. This can best be done by first keeping accurate records of all incidents and accidents and then periodically evaluating those records to determine trends and conditions that must be corrected.

c. Third level, special attention must be given to the protection of people and property, should an unplanned release of energy or hazardous material occur.

Causes of accidents. The Guidelines for Hazard Evaluation Procedures (1985), published by the American Institute of Chemical Engineers, divide accident causes into basic, indirect and direct. Basic causes of accidents can usually be traced to poor management policies and decisions. Unsafe acts and conditions due to poor management can be categorized as indirect causes of accidents, along with personal factors such as lack of skill, poor vision, or use of drugs, or alcohol. Unplanned releases of energy and/or hazardous materials are direct causes of accidents resulting from unsafe conditions and unsafe acts. In order to prevent the occurrence or to minimize the impact of an accident, each of the three categories of accident causes must be analyzed and properly managed.

Consistent with Accident Prevention (1987), and Laboratory Safety (1991), as mentioned previously, Brown specifies that the major causes of accidents in industrial education laboratories include:

- Too little laboratory space.

- Unfavorable environmental conditions such as ineffectual lighting and poor ventilation.
- Unsafe electrical systems.
- Lack of or improper types of fire extinguishers.
- Insufficient storage space for materials.
- Unwise selection of equipment.
- Ineffective laboratory organization.
- Unsatisfactory laboratory maintenance.
- Machine guards that are missing, defective or poorly designed.
- Lack of safety glasses, safety shoes, face shields and other safety devices.
- Inadequate means of handling flammable materials and wastes.
- Classes that are too large.
- Courses of study requiring activities that are beyond the capabilities of some students.
- Inadequate safety instruction.
- Teacher's careless work habits.
- Safety rules not enforced.
- Poor attitudes toward safety.
- Lack of effective class discipline.
- Lack of skill.
- Fear of equipment.

- Physical defects, such as poor eyesight and hearing loss.
- Unsafe clothing worn by students (long ties, long sleeves, rings, etc.)

Consideration of these causes makes three conclusions inescapable:

I. Each is a condition that can be prevented or offset.

II. Unless a teacher makes a purposeful effort to achieve satisfactory laboratory safety, accidents will probably occur, and,

III. The most important means of promoting safety are skillful laboratory planning, proper laboratory maintenance, and good teaching.

Every industrial teacher must make a determined effort to minimize the seriousness and effects of accidents that occur. Each accident should be carefully analyzed so that its causes can be discovered and steps can be taken to prevent a recurrence. This is of scant comfort to a student who has sustained an injury but of great benefit to those who might otherwise be injured in the same way. A well designed, comprehensive accident report form can be instrumental in determining causes of accidents.

According to Brown, course organization is the logical starting point for a laboratory program to be administered so that accidents are avoidable. Courses must be designed to interest and challenge students at their own levels of capability so that no one is handicapped by course content that presents too great a challenge or represents no real challenge at all. Boredom and irritation caused by lack of purpose can result in accidents. Consequently the often stated ideal,

that courses should provide for individual differences must represent conviction rather than mere vervalism. Also according to Brown, unit safety tests covering the use of hazardous machines should be given, and students should be required to pass each test with a perfect score before operating the equipment. For their part, industrial teachers must understand all federal, state, and local safety statues: give adequate safety instruction; avoid making students afraid of equipment; and provide proper supervision whenever a class is in session. Teachers must never be absent from a laboratory when students are using power tools, and should always be alert to detect unsafe acts or conditions. Teachers should also watch for evidence of physical defects, poor physical health, or poor mental health in students. If any of these conditions is discovered, it should be brought to the attention of the appropriate school administrative officer, and the student should not be allowed to operate power tools until the problem has been resolved and workstation accommodations made.

A second important means of promoting safety, in an agriscience laboratory, is a maintenance program designed to ensure that each piece of equipment will be in its best operating conditions at all times. Dull cutting edges, worn parts, lack of lubrication, improper adjustment, damage, absence or improper functioning of protective devices, unsafe storage of equipment, and other deficiencies should be corrected as soon as they have been discovered, even if it is necessary to remove pieces of equipment from service for short periods of time.

Safety Audits. A safety audit can be used to measure the effectiveness of an organization's safety and health program in meeting its goals and objectives (U.S. Department of Labor, "Accident Investigation").

It further says: A properly conducted safety and health audit should accomplish the following:

- Determine if the organization's safety and health program is meeting its objectives and goals.
- Establish a basis for facility organization, personnel participation and accountability in safety matters.
- Evaluate the effectiveness of the organization's safety and health program regardless of the strength and weakness of other areas within the organization.
- Detect and correct any operations, procedures, and/or equipment that is in violation of federal, state, or local laws, regulations, and standards.
- Identify the strength and weakness of the current safety and health program.
- Facilitate the formulation of an improvement plan that can easily be communicated to all levels of the organization.

According to the coverage of the safety audits they can be comprehensive, limited, formal, and informal. According to who makes the safety audits, they can be internal (self review) or external (independent review). An internal review can

be conducted either by an inspection team composed of supervisors and/or teachers. The advantages of an internal audit include the auditor's knowledge of the organization and the low cost associated with this type of audit. An internal audit could have the disadvantage of being biased because it is a self evaluation. An external audit normally is conducted by outside consultants hired by the organization. The major advantage of an external audit is its objectivity: that is, it provides an opportunity for independent evaluation. This type of audit also provides better expertise in terms of identification and rectification of safety problems. The disadvantages of an external audit include the auditors lack of familiarity with facility and personnel, the audit's relatively high cost, and the possibility of no or minimum follow-up."

Inspections. Consistent with the above, Hammer, Occupational Safety Management and Engineering, make reference to safety inspections relative to the workplace. Such reference translated to the agriscience laboratory environment, would indicate that safety inspections can be either informal or formal types. An informal inspection can be conducted by a teacher who ensures every morning that the facilities and equipment are in proper condition prior to the start of classes or instruction, or to observe if the students are conducting themselves suitably. Similar informal inspections can also be conducted by higher-level supervisors.

More formal inspections can be conducted by safety personnel, fire prevention personnel, insurance company engineers, or municipal, state, or

federal representatives. Personnel in the last three categories are generally highly experienced and trained professionals and use proved methodologies. Procedures they follow are beneficial to anyone making a formal inspection.

The South Carolina State Department of Education (1981), in reference to safety inspections recommends:

a. Use a safety check list to assure that all safety factors are checked during safety inspections.

b. Have in-depth safety inspections of the industrial arts facility made at least annually, by:

- School personnel - state and/or local level.
- A student safety committee.
- A student inspector or foreman.

c. Encourage teachers to welcome inspections by:

- Insurance safety engineers.
- Inspectors from the State Department of Labor and Industry.
- State fire inspectors.
- Advisory Committee Members.

d. Rotate assignments of students to the safety committee.

George & Perkins (1987), stressed the necessity of safety inspections in agriscience laboratories addressing teachers to schedule safety inspections as follows: "If you can't hire an expert, assume the role yourself. Pretend you are a stranger to your school. Take an objective look at the safety showers, eyewash

fountains, fire extinguishers, and first aid kits. Check that fume hoods are not being used as storage areas and that all chemicals are labeled properly. Don't take piles of flammable papers for granted as you make your rounds. Then, pretend you are a student, and imaging what havoc you might create, especially if unsupervised. Keep a log. Repeat your inspection monthly. Be sure to include the storeroom in your rounds. Become reacquainted with the chemicals stored there. Make sure every bottle is labeled fully; store your chemicals by class, not alphabetically."

Greene (1985), in reference to regular inspections on school shops, states: "School staff always should be on the lookout for hazardous conditions such as puddles of water, frayed electrical wires, cracked windows, or protruding nails. They should know to report any problems promptly so that safety measures can be taken until the condition is remedied." Greene also stresses that regular inspections are essential, and that in addition to inspections conducted by the school principal or facilities staff, it is a good idea for each school to have a safety committee to provide ongoing surveillance of the school environment.

To stress the importance of a safety committee, Greene makes reference to Robert Russel, former Fairfax County, VA secondary school principal and currently superintendent of Fairfax City, VA Public Schools, as saying: "We all have blind spots, and every school needs a safety committee to find the problems missed by people who spend all their time in the building." The former principal's

school safety committee included parents, and Russell made a point of rotating membership to guarantee "fresh eyes".

Tools. One tool that safety inspections must use is the checklist. According to Hammer an inspection checklist is used to indicate the conditions and equipment they will inspect and also to constitute a record of findings." He also points out certain characteristics of a checklist that is convenient to bring out here, as follows:

- High risk operations and activities are noted on the checklists to be given special attention.
- Findings during previous inspections are reviewed to determine whether any discrepancies have been found, and if so, whether they had been corrected.
- Personnel making inspections are suitably equipped, with hard hats, safety shoes, safety glasses, and other protective equipment prescribed for the areas they are to visit.
- A report of inspection is prepared and presented to the responsible supervisor and/or to the principal. A preliminary report may be given verbally to the supervisor whose area or equipment has been inspected.
- Findings in the report are specific and not generalities, naming locations, equipment, and operations with pertinent discrepancies.

(Note: Stating that housekeeping in a described location was generally poor is a specific finding).

- The report may present recommendations for corrective action that should be taken.
- If the discrepancies violate any governmental standards, codes, or regulations, the specific document, paragraph, and requirement are cited.

CHAPTER 3

RESEARCH PROCEDURES

3.1 Statement of the problem (Rationale)

The previous literature review clearly indicates that the rapid advance of industrial technology has brought about new materials, methods, and developments, and that automation, increased production, scientific engineering and changing occupational needs are indicators of dynamic technological progress. Such advance in technological progress has in turn brought about the expansion of school curricula into laboratory courses where the use of hazardous tools, materials and equipment by students in agriscience is necessary for their instruction in both technological and safety practices.

The literature review also suggests that agriscience as well as vocational programs in schools need to go with this rapid advance of technology.

Also from the literature review and interviews with some agriscience educators there is a clear and evident responsibility of school administrators for providing a safe environment for the students and a program of instruction with emphasis on effective safety practices, as well as an increasing concern among educators about the safety conditions of students involved in agriscience programs.

Furthermore, consideration must be given to the possibility that the improved safety devices, procedures, regulations and policies that the advancement of industrial technology constantly brings about into the workplace,

may not reach those that are in their early stages of learning in the agriscience laboratories.

There has been some research in the area of safety conditions in agriscience laboratories in other states and institutions. Some make reference to unsafe conditions found in these laboratories or some suggest the need for improvement of safety conditions or further research. In the literature surveyed, no information was found concerning safety conditions or safety practices in the agriscience laboratories of the high schools of the State of Louisiana.

There are no records kept in the State of Louisiana as to the frequency of student accidents in agriscience laboratories. The office of Risk Management of the Division of Administration of the State of Louisiana keeps records of the comprehensive general liability claims. The listings include claims other than injuries to students, and the students referred to are Vo-Tech students. Vo-Tech students carry a different course and laboratory load than the agriscience laboratory students, which were the concern of this research. In consequence, the information available was of very little value to this work.

The Department of Education of the State of Louisiana has published a General Safety and Health Manual for Technical, Vocational and Technology Education Programs (1992), Bulletin #1674. Even though this publication was made as a manual for Vo-Tech programs, it is an excellent local reference for the present and future research and investigations. The publication of this bulletin

reflects the concern of the Department of Education of the State of Louisiana for the safety of students involved in laboratory work.

From all of the above, a need did exist to examine the safety conditions of the Louisiana agriscience laboratories. Regular assessments and examinations of the safety conditions of the Louisiana agriscience laboratories are needed to provide an indication of their degree of safety. This will help obtain or maintain the support of the institutions and the communities for safe programs of instruction, and improvement or maintenance of safety conditions in the agriscience laboratories.

A methodology, or tool to perform these regular assessments is necessary and should be made available to the groups involved.

3.2 Methodology

A research plan was developed to accomplish the objectives of this research . As stated in Chapter I, Section 1.2, the objectives of this research were:

I. To develop a methodology to assess the safety conditions of the facilities, materials, equipment and instructional safety methods used in agriscience laboratories in Southeastern Louisiana.

II. To validate and improve the above methodology, as it is developed, by interviewing teachers and examining data collected from the southeastern Louisiana agriscience laboratories through the use of this tool.

III. To identify the most common safety problems in agriscience laboratories, if any, as the above methodology is developed and validated, and suggest most appropriate solutions or means for improvements.

IV. To make recommendations about the best use of a validated and improved methodology, for future research and safety assessments.

The proposed research methodology is illustrated in Figure 3.1, and described as follows:

Phase I. Survey Study.

A. Design a survey study of the safety conditions at four agriscience laboratories located in the South Central Louisiana, an area different from the research area. To design this survey study, develop a hypothesized survey model utilizing conceptual references and frameworks obtained from the literature review. This tool or instrument will have different sections according to the nature of the conditions being examined. Each section will have different lines that will represent the items being questioned or observed. Each one will be graded as to being safe, not safe, or safe but in need of improvement. Each one of these three grades will have three categories of, low, medium, and high. The grading will depend on safety standards, if available,

METHODOLOGY

To assess safety conditions of the Southeastern Louisiana Agriscience Laboratories

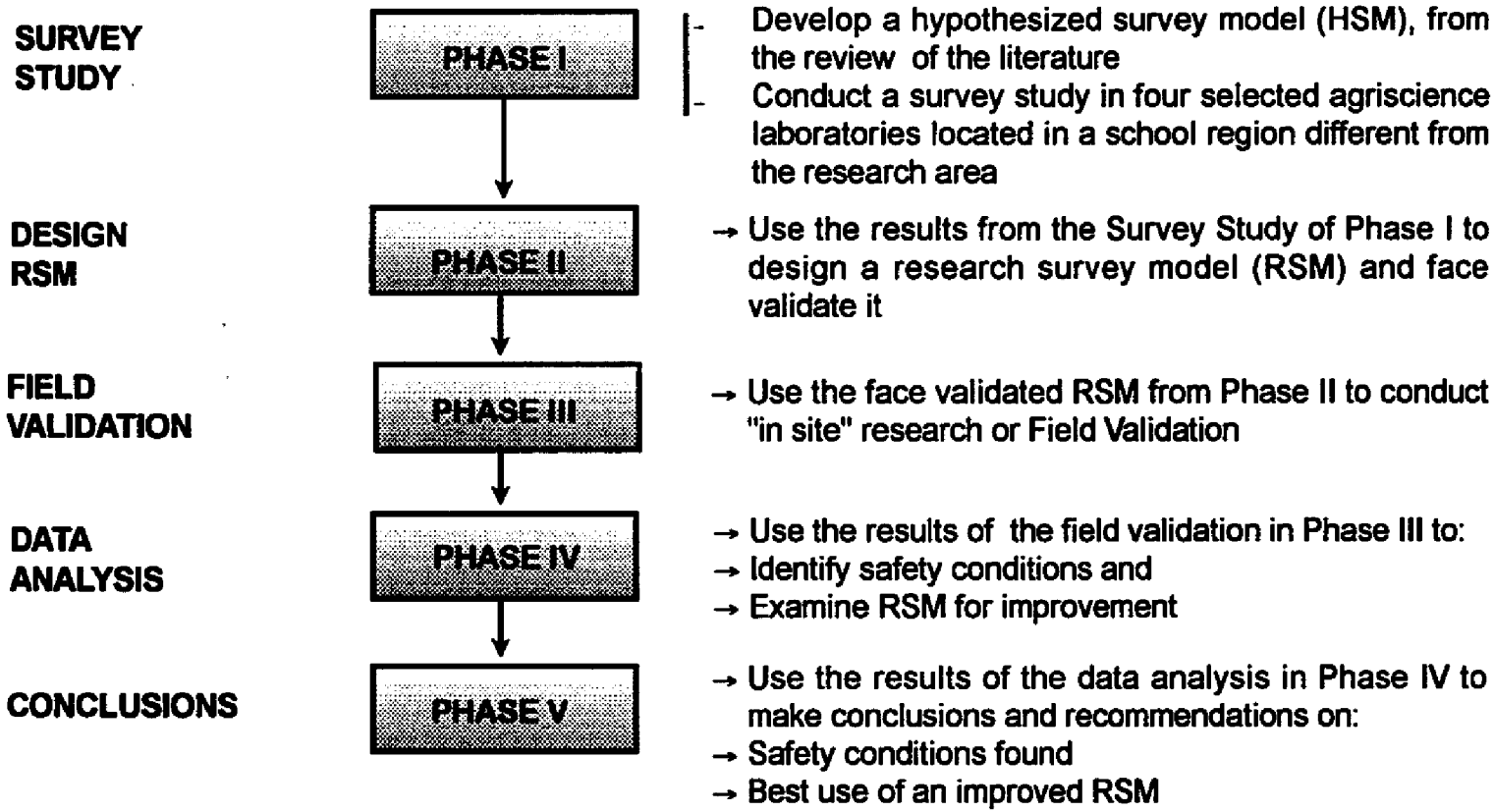

Fig. 3.1 Methodology

actual measurements, observations, inputs from the teachers interviewed, or consensus between the researcher and the teacher interviewed. The learning environment as described in Chapter I, Section 1.1, and Fig. 1.1, the physical environment with its two interacting environments, the institutional and the community environments, was the subject of this research.

B. Field validate the hypothesized survey model as initial instrument of research, by contacting, visiting and surveying these four agriscience laboratories in South Central Louisiana.

C. Study and examine the information obtained, in order to advance to Phase II, which will be the development of a Research Survey Model (RSM).

Phase II. The Research Survey Model (RSM).

A. Design a Research Survey Model of the safety conditions of Southeastern Louisiana agriscience laboratories.

B. Use the information obtained from the use of the field validated hypothesized model in Phase I, to develop a RSM. Again, the learning environment, as described in Chapter I, Section 1.1 and Fig. 1.1, the physical environment with its

two other interacting environments, was the subject of this research.

C. Submit the RSM for the evaluation or face validity to the faculties of Biological and Agricultural Engineering, Industrial Engineering and Vocational Education.

Phase III. Field Validation. (Data collection)

A. Conduct a research survey of every agriscience laboratory of Southeastern Louisiana utilizing the face validated RSM, as tool or instrument, in order to field validate it.

B. To conduct this research survey and field validate the RSM, contact all the high schools of the states's southeastern region, to collect data utilizing this RSM through personal interviews with teachers and actual site assessments of the facilities.

Phase IV. Data Analysis.

After completion of the research survey through assessments "in situ" and interviews with the teachers, the data was compiled and examined to comply with the last two research objectives of improving the RSM for future use, and, identifying safety problem areas, if any.

To analyze the data collected from all the schools, pure descriptive statistical methods were utilized in such a way that the different trends and the most common safety problems, if any, could be identified. Every high school in

Southeastern Louisiana was to be included in the research, that is, the whole population of high schools.

Phase V. Conclusions.

A. Present findings about the safety conditions of the Southeastern Louisiana agriscience laboratories.

B. Present suggestions about the most appropriate means for the improvement of safety conditions.

C. Make recommendations about the use of the improved RSM.

D. Make recommendations about all other situations regarding this research that arise from the individual assessments and the data analysis that was to be conducted.

CHAPTER 4

FIELD WORK

4.1 Phase I.- Survey Study

After a thorough review of the literature, a hypothesized survey model (HSM) was developed and face validated by the faculties of Biological and Agricultural Engineering, Industrial Engineering and Vocational Education. This HSM was field validated by visiting and assessing four different agriscience laboratories of high schools located in South Central Louisiana, a geographical area different from the selected research area. The hypothesized survey model (HSM) is shown in Appendix A.

To develop this HSM, the following sources were consulted:

1. Brown, Robert D., 1979, Industrial Education Facilities.
2. Fletcher, W. E. & Johnson, D. M., 1990, Safety Practices and Equipment Used in Mississippi Secondary Agricultural Mechanics Laboratories.
3. Greene, Brenda Z., 1985, Protect against personal injury to limit your liability.
4. Hammer, Willie, Occupational Safety Management and Engineering.
5. South Carolina Industrial Arts Safety Guide, 1991, South Carolina State Department of Education.

6. Laboratory Safety, 1991, U.S. Department of Labor. Safety Manual No. 4S.

7. All About OSHA, 1976, OSHA 2056. U. S. Department of Labor.

8. General safety and health manual for technical, vocational and technology education programs. Bulletin No. 1674. Louisiana Department of Education.

9. Burke, S. R., 1989, Accidents in Virginia secondary agricultural programs.

10. The National Standard School Shop Safety Check List.

11. Accident Investigation (1987), US. Department of Labor.

12. Guidelines for Hazard Evaluation Procedures. American Institute of Chemical Engineers.

Conceptual references and frameworks obtained from these sources were used in the development of the HSM. Consideration was placed into the physical environment and their two interacting environments, the institutional and the community, which compose the learning environment, as described in Chapter I, Section 1.1, and Fig. 1.1.

4.2 Phase II.- Design RSM

As a result of the field validation through visits, assessments and discussions with the agriscience teachers, in Phase I, a Research Survey Model (RSM), was developed. It was made in two parts. Part one had 103

data items for collection by the researcher at the facilities in consensus with the agriscience teacher. Part two had 107 data items for collection by the researcher from the agriscience teacher after being instructed and advised. A total of 210 data items were collected per site assessment. Additional information was collected including some pertinent demographic data.

Every data item was assigned a safety rating or a score of one to ten with ten representing the safest condition. This RSM, shown in Appendix B, was also face validated by the faculties of Biological and Agricultural Engineering, Industrial Engineering and Vocational Education.

4.3 Phase III.- Field Validation (Data Collection)

The research area included all the agriscience laboratories of the high schools of the Southeastern area of the State of Louisiana, which comprises the parishes of East Baton Rouge, Assumption, Livingston, Tangipahoa, Washington, St. Helena, St. Tammany, Lafourche, St. James, Point Coupeè, East Feliciana, West Feliciana, St. John, and Ascension.

Forty-four high schools were reported to have agriscience laboratories, and were selected to participate in this study. Forty-one of these were assessed, and three were missed for diverse circumstances accountable to the corresponding schools. It was therefore considered that the whole population of schools in the research area had been assessed. A total of 9,645 data items were collected, and all entries were compiled and analyzed. The researcher took an average of one hour per actual site

laboratory assessment. The assessments were made only on the physical environment (part one), and on the institutional and the community environments (part two).

Part one was divided in seven different sections as follows:

- Building
- Environment
- Machines and equipment
- Safety conditions
- Housekeeping
- Fire protection
- Ergonomics and safety engineering

Part two was divided into different sectors as follows:

- School safety policies and procedures
- General safety practices
- Personal protective equipment
- Fire protection

Because only the three mentioned environments were being assessed, students were not required to be present or laboratories did not need to be in session. Agriscience teachers were contacted previously to verify their acceptance to participate in this research and to schedule appointments. A cellular phone was used to contact them, because they could be reached only at times when the researcher was in the field. Due to

the generally widespread distances between schools, and the availability of the teachers, only one or two laboratories per school day could be assessed. The data collected on the first part of the instrument or RSM was actually collected "in situ" by the researcher in consensus with the corresponding agriscience teacher. The data collected in the second part of the instrument or RSM was supplied also "in situ" by the agriscience teacher after being instructed and advised by the researcher. The data contained in this second part was mostly relative to the interacting institutional and community environments, of which the agriscience teacher was considered to be the best knowledgeable source.

Not all items to be assessed were applicable to all laboratories. Provisions were made in the RSM for non applicable items. They were not to be considered in the subsequent calculations. The data collected is shown in Appendix C.

4.4 Relative importance of items assessed

All the items assessed do not have the same impact relative to laboratory safety. Due to this varying impact, a factor of relative importance to safety was considered necessary to be applied to the collected data, in order to obtain a balanced safety index that would represent both the safety rating and the level of importance of each item assessed.

Therefore, a system was designed to apply a factor of relative safety importance to each item assessed. The system consisted of selecting six

safety officers or experts whose services were offered on the LSU campus, and requesting their evaluations of the items assessed as to their relative importance to laboratory safety. A list of all 210 items was individually evaluated by these experts on a scale of one to five, one indicating that the items was of least relative safety importance, and five indicating that the items was of greatest relative safety importance.

The individuals who made these evaluations contributed very significantly to this research and are listed below:

- Dr. Fereydon Aghazadeh, Industrial Engineering Department, Professor of Industrial Engineering.
- Dr. Richard Parish, Biological and Agricultural Engineering Department, former safety officer of this Department.
- Mr. Michael Hooks, CHMM, Assistant Safety Officer, LSU Office of Occupational and Environmental Safety.
- Dr. Dough Deason, LSU Agricultural Center, Cooperative Extension Service, Specialist (Crop Processing, Storage, Electrification, 4-H Electric Program and Farm Safety).
- Dr. Lynn Hannaman, LSU Agricultural Center, Cooperative Extension Service, Specialist (Farm Structures, Plan Service), former industrial arts teacher and university professor of agricultural mechanization.
- Mr. Ray McManus, LSU Agricultural Center, Safety Officer.

4.5 Demographic information

In order to obtain a cross section of the research area it was considered convenient to obtain some pertinent demographic information from the schools assessed. Therefore, a set of demographic data was collected at every school.

The demographic information collected at every school was the following:

- School population
- Area of each agriscience laboratory
- Maximum number of students allowed per laboratory session

The school population and the maximum number of students allowed per laboratory session were obtained from the teachers, and the areas of the agriscience laboratories were actually measured. From the above demographic data, the critical area of laboratory per student in laboratory session was calculated as the ratio of the area of each agriscience laboratory to the maximum number of students allowed per laboratory session. The latter gives the smallest critical area that a student has to work in, when a laboratory is in session.

CHAPTER 5

ANALYSIS AND RESULTS

5.1 Demographic statistics

The demographic information obtained was found to be very diverse. The total number of students enrolled in the 41 schools was 34,500. School populations ranged from 260 to 1,800 students, with an average of 838 and a median of 422. The size of the laboratories varied from 648 to 8,358 square feet, an average of 2,093 and a median of 1,716. The maximum number of students the teachers allow per laboratory session ranged from 10 to 36 students, both mean and median of 26 students. The critical area per student in a laboratory session ranged from 34 to 194 square feet, an average of 85 and median of 73 sq. ft. The demographic information of the schools assessed is presented in Table 5.1, and in the histograms that are shown in Appendix D.

5.2 Relative safety importance factor (RSIF)

Appendix E shows the list of the 210 items and the evaluations made by the six campus safety experts mentioned in the previous chapter. The average of these six evaluations was calculated for each item and referred to as the relative safety importance factor (RSIF). The mean RSIF (relative safety importance factor) for all 210 items was calculated to be 3.89.

Table 5.1 Demographic Statistics

DEMOGRAPHIC STATISTICS							
	Largest	**Smallest**	**Range**	**Mean**	**Median**	**St. Dev.**	**Units**
School population	1800	260	1540	838	632	422	Students
Agriscience laboratory areas	8358	648	4710	2093	1716	1087	Sq. ft.
Maximum number of students per laboratory session	36	10	26	26	26	6.53	Students
Critical area per student in laboratory session	194	34	160	85	73	40.65	Sq. ft.

5.3 Safety need index

Because of the varying impact to laboratory safety of the items assessed, the relative safety importance factor (RSIF) was applied to the collected data, obtaining a safety need index (SNI) that combines the field safety rating and the level of importance of each item assessed in a balanced numerical representation. This index (SNI) is a modified relative safety level of the items assessed that shows more accurately their need for improvement because of their combined field safety rating and their impact or importance to laboratory safety.

A formula was designed to calculate the safety need index (SNI). This formula will increase the individual field safety rating, when the relative safety importance factor (RSIF) for that item is lower than the mean relative safety importance factor (RSIF) for all items, and will decrease the individual field safety rating, when the relative safety importance factor (RSIF) for that item is higher than the mean relative safety importance factor (RSIF) for all items. In other words, by this formula, as an individual item is considered of more safety importance than the average, its assessed rating is affected negatively showing more need for improvement because of its greater importance. On the contrary, as an individual item is considered of less safety importance than the average, its assessed rating is affected positively showing less need for improvement because of its lesser importance.

The designed formula to attain a safety need index (SNI) of each item assessed is the following:

$$SNI = FSR + [(\mu - f)/\mu] * FSR$$

where,

SNI = Safety need index, as a percentage

FSR = Field safety rating

f = relative safety importance factor (RSIF)

μ = mean relative safety importance factor = 3.89 *

* The mean factor of relative importance, μ, for all 210 items was calculated to be 3.89.

The SNI's obtained through the use of this formula were converted to percentages in order for these numerical values to be more expressive. In order to obtain these percentages the calculated SNI's were mathematically compared to the highest SNI obtained.

5.4 Safety need index (SNI) per sector

The safety items had been grouped in sectors in both parts of the RSM. The average of all SNI's in the sectors were found as follows:

- Fire protection 42.6%
- Safety policies and procedures 47.5%
- Safety conditions 49.7%
- Personal protective equipment 51.0%
- Environment 54.7%

- Machines and equipment 55.6%
- General safety practices 57.5%
- Housekeeping 61.3%
- Fire prevention 64.1%
- Building 67.1%
- Ergonomics and safety engineering 71.7%

The above distribution is shown in Fig. 5.1. It shows that the weaker sectors in laboratory safety are fire protection, school policies and procedures, safety conditions, and personal protective equipment, whereas the stronger sectors are housekeeping, fire prevention, building, and, ergonomics and safety conditions. The latest being the stronger sector in laboratory safety.

The fire protection sector must be differentiated from the fire prevention sector. Fire protection refers to items related to protection in case of fire occurrence, whereas fire prevention refers to items related prevention of fire occurrence. The fire prevention items are generally supervised and inspected by the local fire marshals. In general, the sectors that are weaker in laboratory safety require emphasis in the implementation of better measures to provide better protective equipment, fire proof utensils, improvement of safety conditions, and implementation of more suitable safety policies and procedures.

On the other hand, fire preventative measures, condition of buildings and, ergonomic and safety engineering require less emphasis to attain safety improve-

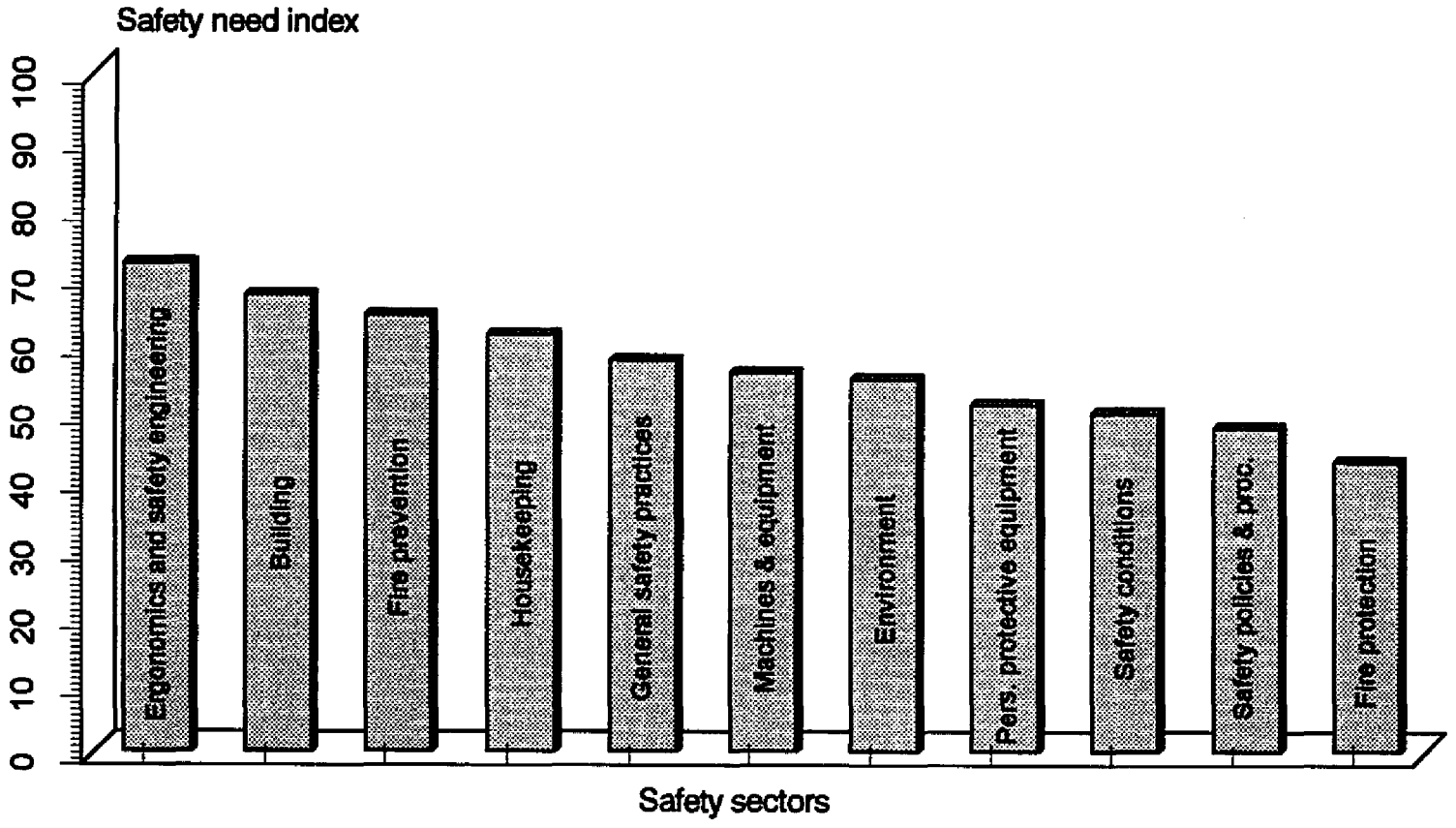

Fig. 5.1 Safety Need Index (SNI) per Sector

ment. Environment, machines and equipment, general safety practices and housekeeping require moderate emphasis to attain safety improvement.

5.5 School safety need index (SSNI)

The individual school safety need indexes (SSNI's) were calculated after a compensation was made for non applicable items found in each individual school assessment. The following formula was used to obtain the individual SSNI:

$$SNNI = T + (210 - NA's)$$

Where,

SNNI = School safety need index

T = Total of the 210 SSNI's per school

NA's = Number of non applicable items per school

210 being the number of items assessed.

The SSNI's are shown in the Histogram in Fig. 5.2. This histogram is divided up in quartiles, showing the following distribution of the SSNI's:

- Lower quartile: 42.8 - 53.8%
- Second quartile: 54.1 - 57.9%
- Third quartile: 57.9 - 61.7%
- Upper quartile: 62.1 - 69.2%

The above quartile distribution reveals that the 10 laboratories (25%) in the lower quartile (laboratories with lower SSNI's), ranked between 42.8 - 53.8%. The percent spread in this quartile (11.0) is much higher than the spread in the

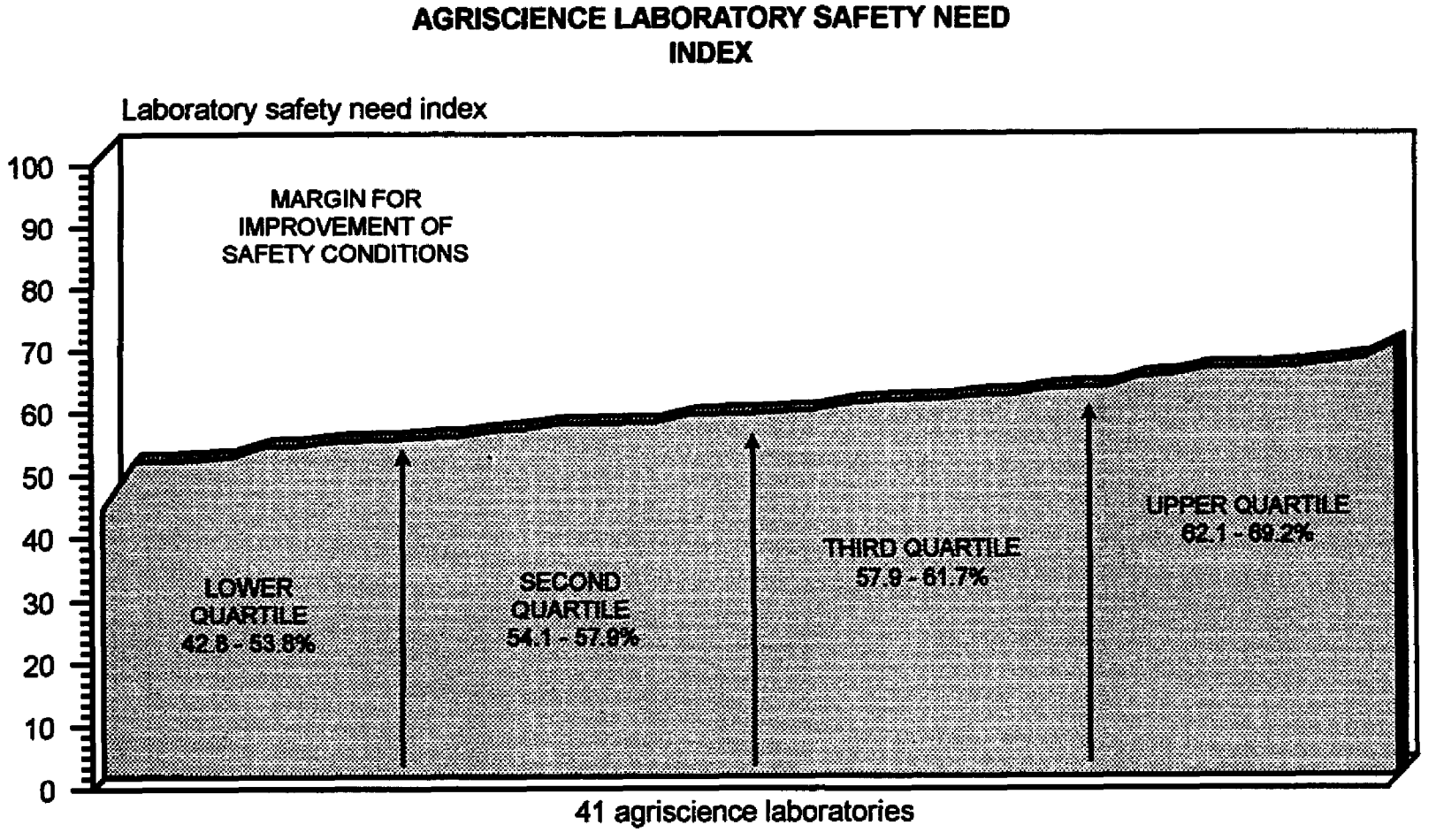

Fig. 5.2 Agriscience Laboratory Safety Need Index

other three quartiles (4.1, 3.8 and 7.1) indicating that a few schools ranked very low compared to the rest, actually very poorly. On the other hand, the 20 schools (or 50% of all schools) that fell in the two middle quartiles ranked between 54.1 and 61.7%, had only a percentage spread of 7.6.

Fig. 5.3 shows a two pie chart. The first pie illustrates in its first portion, the mean SSNI obtained for all schools, which was found to be 58.2%. The remaining portion illustrates that there is a space for improvement of the safety conditions of 41.8%. The second pie illustrates what percentage of this space for improvement of safety conditions corresponds to the sectors shown in Fig. 5.1.

The percentages mentioned above are as follows:

• Fire protection	12.0%
• Safety policies and procedures	11.0%
• Safety conditions	10.5%
• Personal protective equipment	10.3%
• Environment	9.5%
• Machines and equipment	9.3%
• General safety practices	8.9%
• Housekeeping	8.1%
• Fire prevention	7.5%
• Building	6.9%
• Ergonomics and safety engineering	5.9%
Total	100.0%

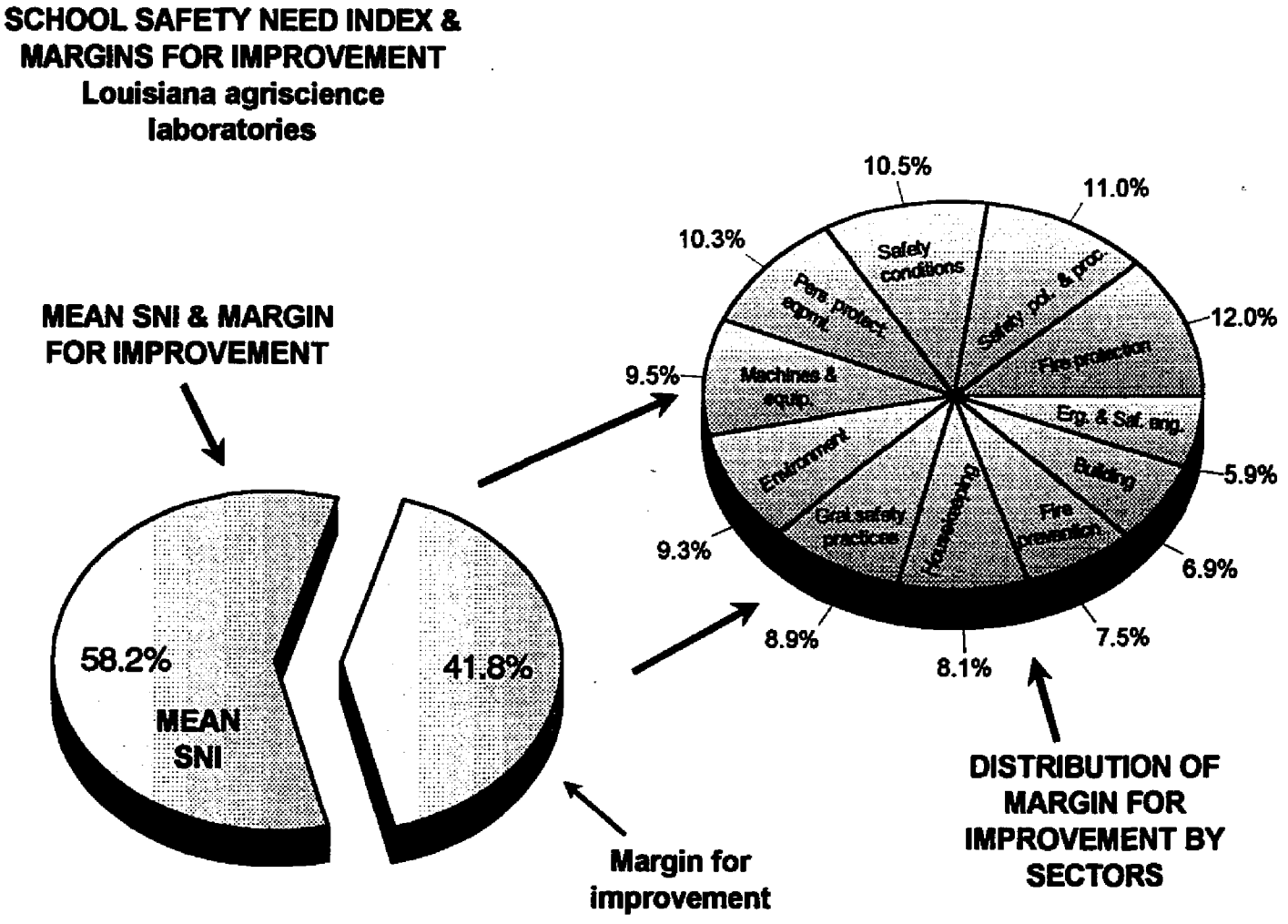

Fig. 5.3 Safety Need Index (SNI) and Margin for Improvement

The above distribution emphasizes what has been discussed in paragraph 5.3 and is intended to be used in identifying sectorized safety problems that need to be addressed if solutions are to be found. Each percentage indicated for a sector indicates how much of the safety problems in the whole context corresponds to the particular sector; for example, 9.5 percent of the whole safety problem in the agriscience laboratories is concentrated in the environment sector, and 8.1 percent is concentrated in the housekeeping sector.

5.6 Itemized safety need index (ISNI)

The SNI's per item or Itemized safety need indexes (ISNI's) were also compensated for non-applicable situations found in each individual assessment. The following formula was used to obtain this compensation:

$$ISNI = T + (41 - NA's)$$

Where,

ISNI = Itemized safety need index

T = Total of the 41 itemized safety need indexes

NA's = Number of non applicable situations

41 being the number of SNI's calculated per item.

A histogram of all the safety items assessed is shown in Fig. 5.4. To facilitate the identification of safety problems this histogram is shown in quartiles, as follows:

- Lower quartile: 8.7 - 46.1%
- Second quartile: 46.5 - 61.4%

ITEMIZED SAFETY NEED INDEXES (ISNI's)

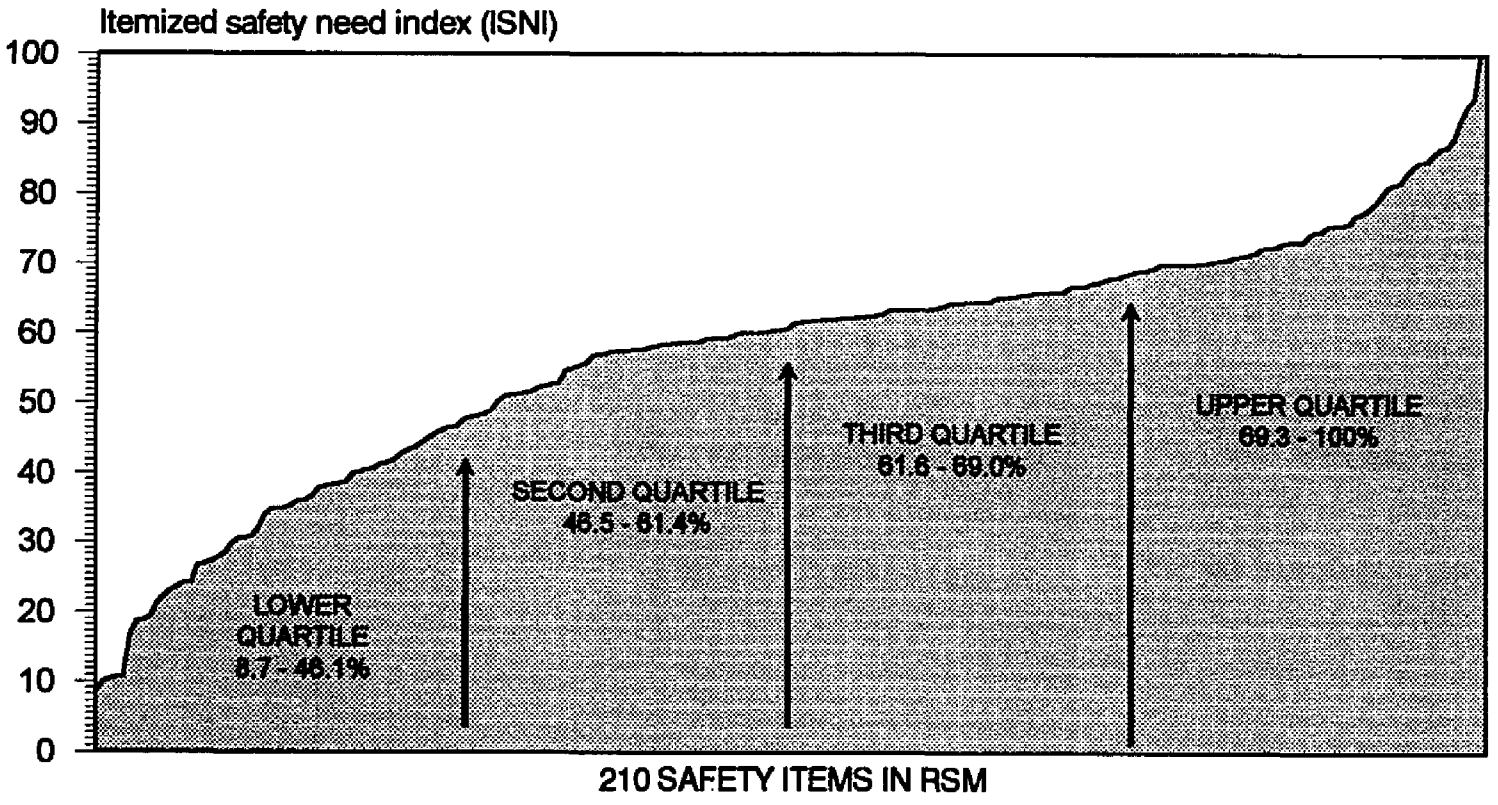

Fig. 5.4 Itemized Safety Need Indexes

- Third quartile: 61.6 - 69.0%
- Upper quartile: 69.3 - 100%

The 210 safety items that are included in all four quartiles are shown in Appendix F. The ISNI's in the 41 schools is the information that leads to the identification of specific safety problems.

The quartiles will list 52 to 53 items (25% each) in ascending order of ISNI's. The lower quartile lists the items that ranked lower. The second, third and upper quartiles list also in ascending order all items in other categories of ISNI's. The upper quartile will list the items that ranked higher.

Appendix G shows a relationship between the FSR's (Field safety ratings), the RSIF's (Relative safety importance factors) and the SNI's (Safety need indexes) for all the items assessed. The first column in this appendix shows the number of non applicable situations.

CHAPTER 6

CONCLUSIONS AND RECOMMENDATIONS

As a result of this research, some interesting conclusions and recommendations are made relative to the conditions of safety of the agriscience laboratories in Southeastern Louisiana. There is now a better documented knowledge of the present safety conditions of the agriscience laboratories of Southeastern Louisiana. Such knowledge should be as important as it is to know the safety conditions of the highways, the work places, the public places, etc. It is also important for the people that decide where public funds are disbursed, or whether they should invest in better safety conditions in schools and particularly in areas of higher risk.

On the other hand, teachers, supervisors, and others, should now be better acquainted with the safety conditions of their agriscience laboratories and thus be able to support funding, in a way that they can continuously promote improvement of safety conditions and reach a better and safer learning environment for the children.

6.1 Conclusions

The methodology developed to assess safety conditions in the Louisiana agriscience laboratories has been tested in the field providing some interesting conclusions. These laboratories have been assessed and rated for safety. The safety ratings and indexes found per item assessed, school safety ratings and

indexes, and the overall safety need index show that there are moderate to serious safety problems in the agriscience laboratories.

The space or margin for safety improvement is very concise. If properly tracked, this space can be reduced to provide safer learning environments. Identification of safety problems has been made by analyzing the itemized and sectorized assessments. The very nature of such safety problems shows that most of them can be alleviated.

Summary

The present research have been conducted consistent with the four research objectives set forth in page five. These four objectives have been accomplished according to the following summary of conclusions:

- A methodology to assess the safety conditions of the facilities, materials, equipment and instructional safety methods used in agriscience laboratories in Southeastern Louisiana was developed (Objective # 1).
- The above methodology was field validated successfully. The development and validation of the designed Research Survey Model (RSM) shown in Appendix B was a relevant part of the methodology. It was validated by interviewing teachers and evaluating data collected from the Southeastern Louisiana agriscience laboratories (Objective # 2).

- Most common safety problems in agriscience laboratories have been identified as the above methodology was developed and validated. It has been found that moderate to serious safety problems exist in the agriscience laboratories assessed. Such safety problems have been identified and suggestions for improvement of safety conditions have been addressed after reviewing and analyzing the itemized and sectorized assessments. Some agriscience laboratories need considerable more attention than others regarding safety conditions as shown by the different school safety rating and SNI categories (Objective # 3).
- Recommendations about the best use of a validated and improved methodology, for future research and safety assessments have been made. An improved RSM designed as a result of this successful field validation, can be used for future assessments. A modified methodology can be used to assess safety conditions in other environments, such as in the work place (Objective # 4).

6.2 Most common safety problems

The lower quartile of the itemized safety need indexes includes the safety assessed items that ranked lower, and these items are identified as the ones with outstanding laboratory safety problems. These items are summarized as follows:

- Stairways and railings need to be color coded

- Laboratories need to have an inventory of all chemicals used, materials safety handling sheets, a planned response and procedures for dealing with chemical spills, chemical spill kits, safety showers, eye wash bottles and eye-wash baths and showers available when using caustic materials
- Instructors need to be certified in handling chemicals, first aid certified and have 40 hour hazardous waste training
- Good housekeeping practices need to be always evident
- Laboratory areas need to be provided with custodial services
- Exits need to be adequately and properly identified
- Nonskid surfaces need to be provided around machines and danger zones need to be properly identified and guarded
- All stationary machines need to be securely fastened in place
- Parts of machines needing special caution need to be color coded
- Safety instructions for use of each machine and all safety procedures as well as machine operation instructions need to be posted conspicuously or available near areas of operation
- All main power switches need to be " off " when laboratories are not in session
- Signs need to be always secured to machines that are out of order
- All hand-held power tools need to be equipped with a "dead man" switch

- All guards need to be used at all times, and in addition table saws need to be equipped with anti-kickback system
- Storage cabinets for all flammable liquids, storage and waste containers, and wash tanks for parts that use solvents need to be fire proof
- Safety cans need to be provided for storing flammable liquids
- Fire proof bulk storage need to be provided outside the facilities
- The laboratory need to have fire detectors
- An adequately stocked first aid cabinet need to be provided
- All waste and oily rags need to be placed in the correct containers at all times
- Spray room doors need to swing out and imposible to be locked from the inside
- All welding need to be done in screened and properly ventilated areas
- Respiration and noise suppression devices need to be used as required, and provisions should be made for cleaning and disinfecting of respirators
- Eye-protective devices need to be disinfected and returned to proper racks after use

- The school needs to use the services of a safety inspector or advisor and the laboratory needs to be inspected for safety on a monthly basis
- An inspection checklist needs to be used when making the safety inspections
- Safety inspections of the laboratory should be made also by a student safety committee and the students should be rotated in this committee.

6.3 Improvement of laboratory safety conditions

After a review of the safety ratings and need indexes of all items and of the notes taken at individual laboratories, the following general actions should be taken in order to considerably improve the safety conditions:

Fire prevention and protection

- Ensure that fire extinguishers and fire detectors are sufficient, adequately located, maintained and supplied, and students know their location and use
- Ensure that storage and waste containers, storage cabinets for flammable liquids and wash tanks for parts that use solvents are fire proof
- Ensure that in spray booths, doors swing out and cannot be locked from the inside and filters are replaced regularly

Safety conditions

- Ensure that a master power switch controls all electrical outlets, that an individual power switch controls every machine, that all electrical circuits and outlets are properly enclosed and identified, extension cords are in good conditions, and that temporary wiring is avoided
- Ensure that eye wash bottles and adequately stocked first aid cabinet are provided
- Ensure that all welding is done in screened areas and that cylinders are secured upright and stored in ventilated and clear areas
- Exits, danger zones, and utility lines must be properly identified
- Nonskid surfaces must be provided around machines
- Entrance, exits and stairways must have unobstructed access
- Aisles must be clear of protruding objects
- Walls must be clear of hanging objects that might fall

Safety policies and procedures

- Ensure that the school has a procedure for the administration of first aid, that agriscience teachers are first aid certified or the school has access to qualified individuals to administer first aid
- Ensure that the agriscience teachers carry out safety inspections regularly or the school uses the services of a safety inspector or advisor

- Ensure that all safety procedures are posted conspicuously near all areas of operation, that the number of students per laboratory session or groups for the respective work stations are kept appropriate, and that laboratory areas are provided with custodial services

Personal protection equipment

- Ensure that eye-protection devices as well as respiration and noise suppression devices or other personal protective equipment are used by students and observers as required, washed, disinfected & returned to proper racks after use
- Provisions should be made for cleaning and disinfecting of respirators
- Eye-wash baths and showers should be available if and when using caustic materials

Environment

- Keep facilities pleasant for the students to work, besides their cleanliness and orderliness
- Ventilation, climate control, illumination and space should always be optimum
- All work areas should be provided with non glare lighting
- Air should be free from dust, smoke, or other contaminants

Machines and equipment

- Securely fasten in place all stationary machines
- Color code at least parts of machines needing special caution
- Keep or replace when necessary all machine guards in proper position
- Inspect table saws for a proper anti-kickback system
- Inspect abrasive wheels for proper eye shields
- Inspect radial saws for proper forward stop and positive saw return
- Inspect all hand held power tools for a proper "dead man" switch
- Inspect all hoisting devices for safe operating conditions
- Inspect for proper ventilation in welding areas
- Inspect for auxiliary equipment being orderly and readily available
- Check work stations for adequate process compatibility and to prevent hazards from excess heat, fire, fumes, noise, other machines or passing students

General safety practices

- It is strongly recommended that schools promote and develop the sense of safety consciousness and that laboratories be assessed for safety (hazards and needed corrections) regularly (at least once a month)
- It is recommended to use the instrument developed in this research for safety assessments

- Either safety personnel if available, or the agriscience teachers can conduct this safety assessments, on a regular basis. Inspections should also be made by a student safety committee, with students being rotated is this committee
- All defective equipment and hazards should be reported immediately
- Records of all inspections should be readily available for reference
- All safety problems and requests for improvement, or instruction given should be recorded
- All accidents causing or not causing injuries should be reported and analyzed immediately, and all accident analyses should be used to implement prompt corrective measures
- All laboratories handling chemicals should use materials safety handling sheets and keep an inventory of all chemicals used
- All instructors handling chemicals should be certified in doing so, and should have 40 hour hazardous waste training
- All laboratories should have a planned response for handling chemical spills. Proper warnings should be given in using toxic materials, caustics and volatile materials
- Ensure that all power switches are " off " when laboratories are not in session, when machines are out of service, or when the instructor is out of the laboratory, that machines are kept in safe operating

condition at all times, that operation instructions are posted or available near areas of operation for each machine, that proper tools and materials are always available for machine cleaning, and proper signs or tags are always secured to machines that are out of service, being cleaned or adjusted

- Temperature control for all seasons should be adequate, and noise levels at all laboratory locations, generated at laboratory or from other sources, should never affect speech intelligibility, annoy or distract students or present a health hazard
- Printed safety rules should be given to each student and safety bulletin boards and posters should be part of the safety program
- Fire proof bulk storage if necessary, should be provided outside the facilities and safety cans should always be used for storing flammable liquids
- All waste (shavings, sawdust, paint, etc.), scraps and oily rags should always be placed in the correct containers and disposed of regularly, recommended daily and more frequently if oily rags
- All guards should be used at all times
- Lockers should be kept closed, clean and free from fire hazards
- Occasional talks on safety should be given by industry or outside specialists

- Compressed air should always be reduced to 30 psi when used for cleaning and always provided with proper tip
- Reflective screens should always be used as protection from arc flashes and burns
- Students sleeves should be rolled above elbows when operating machines
- One instructor should have the overall responsibility for each major facility
- Students that constantly violate safety regulations should be removed from work areas
- Students should be instructed in methods for handling and lifting materials
- Extension cords should always be avoided as permanent installations

Housekeeping

- Make good housekeeping practices evident
- Always keep corners and dead spots clean and clear
- Keep machines, benches and tool racks in orderly conditions
- Keep tools, materials and supplies in an orderly and safe condition
- Provide sufficient scrap boxes

Building

- General appearance should be conducive to student safety

- Ensure that floors, walls and ceilings are kept in conditions conducive to student safety and that the facilities are free from evident architectural barriers
- Storage space for tools and materials and for equipments and materials being worked should be adequate
- Stairways must have safe threads and risers, and approved railings
- Mezzanines should be protected with toe boards or railings

Ergonomics and safety engineering

- Ensure that machines, equipment, room furniture, and aisles are properly arranged to provide adequate operator space, adequate teaching, supervisory and demonstration areas, efficient performance and an accident free environment
- Work stations should be free from evident sharp edges, slip and fall or trip hazards, direct or reflected glare sources, and designed to protect observing students from hazards and to prevent hazards from passing students. Local or direct lighting for work stations should be available where needed
- The tasks required from students should be human factors compatible
- The master and other power panels should be easily accessible

- All machine switches, (particularly the "off" switch), dials, controls and displays should be within easy reach of the operators and conform to human factor standards
- Tool racks and safety instructions for use of each machine should be readily available

6.4 General recommendations

A summary of the general recommendations of this research is presented below:

I. An effort should be made to regularly assess safety conditions in order to continuously improve safety conditions.

II. For this purpose, it is recommended to use the improved instrument mentioned before. This instrument for safety assessment on the high school agriscience laboratories should be used regularly (recommended on a monthly basis) by teachers, supervisors and others. The continuous use of this instrument should allow the user to track safety problems, promote and prompt solutions.

III. The methodology validated in this research can be used in other environments, particularly in the work place. A general methodology is suggested in the following paragraph.

IV. As a result of this research it is also recommended to develop and implement safety guides, policies and procedures to help organize safety instruction and safety practices in the future.

6.5 Methodology for other environments

The entire process of this research suggests that the methodology that has been developed could also be used successfully in other environments that require safety assessments, particularly in the work place. Once the environments are known, and all interacting environments identified, it would be possible to use this methodology to assess safety conditions. A recommended methodology to assess safety conditions elsewhere in the work place would be as follows:

- Phase I.- Identify and define the work place and all interacting environments.
- Phase II.- Thoroughly search for background information on the suggested work place and its interacting environments.
- Phase III.- Develop a Hypothesized Survey Model using the background information, and field validate it in a small, similar and representative area.
- Phase IV.- With the results of phase III, design a Survey Model, obtain face validity with safety officers, managers or executives, and then field validate it in the work place.
- Phase V.- Analyze the data obtained and calculate all ratings and indexes, after applying a relative safety importance factor to all items listed.
- Phase VI.- Make conclusions on safety conditions of the particular work place and then improve your Survey Model for future use.

This suggested methodology is shown in Fig. 6.1.

6.6 Recommendations for future research

Since no reliable information was found in the literature regarding injury data for students enrolled in agriscience laboratories, it is strongly suggested that such data, including accident situations with no injury be properly recorded and compiled. Most teachers have indicated that injuries are reported to the administrative office. If there was an accident with no injury, a report may not be written.

On the other hand, there is a questionable relationship between injury or accident occurrence with the safety ratings or need indexes or with the demographic data. It is therefore suggested that some future research be done to establish if there is such a relationship.

The improvement of the methodology that has been developed and the instrument recommended for future assessments of safety conditions in the agriscience laboratories may also be a subject for future research, as well as the use of a modified methodology for safety assessments in other environments.

6.7 Instrument for future assessments.

It was mentioned previously that the RSM, both parts, had been validated successfully. This affirmative statement comes as a result of the acceptance of the parties involved in the validation process, and the results procured. In general, agriscience teachers welcomed the validation process and were most cooperative, giving the best of themselves looking forward for the most accurate assessments

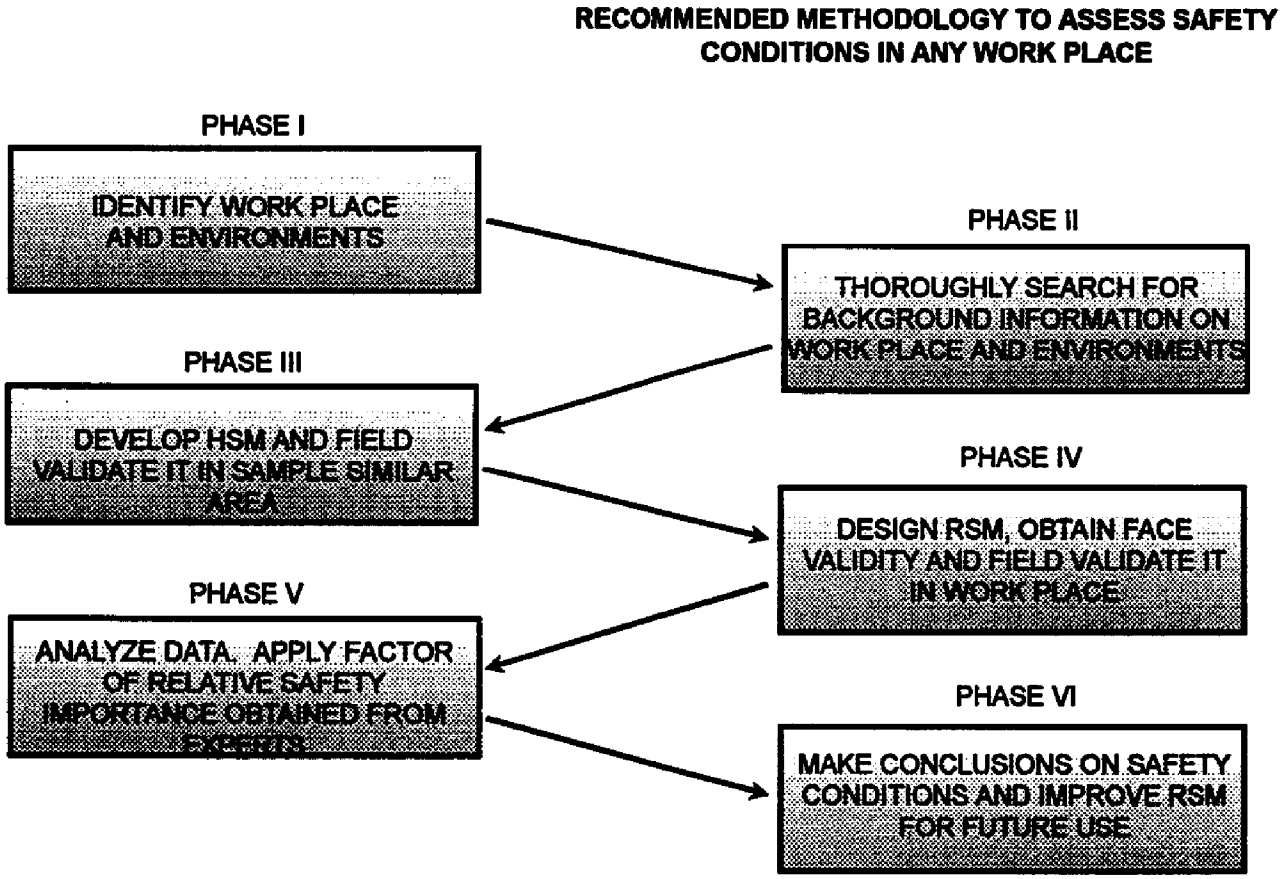

Fig. 6.1 Recommended Methodology

to be obtained, not to mentioned the participation of other school officials. Most safety experts that assessed the relative importance of all items expressed particular and positive interest in this research. Validating the RSM in the field did not present any major problems.

On the other hand, the capacity to improve this instrument, after a careful evaluation of the field assessments, their different parts, and the results obtained, have also led to support this affirmative statement. The instrument, thus, as it was validated, evaluated and improved can be used for future assessments, and also obtain even more successful results. Practical improvements to this instrument have been made with relative promptness after evaluating field validation

In evaluating the RSM with the purpose of improving it, the following actions were taken:

- All items that were 100% non-applicable were eliminated.
- Some items that were generally considered of low importance by the safety experts that evaluated the different items were also eliminated.
- Fire protection and fire prevention, even though a difference exists, have been grouped in only on sector, because of their affinity.
- The RSM had been broken in two parts. One was for the researcher to assess personally and the second one was to obtain the teacher's input particularly on the institutional and the community environments. The new instrument has been consolidated in only

one part. Future assessments using this instrument shall not require that it be broken down. Assessments can be done by one knowledgeable person that is also familiar with the institutional and community environments.

- The new instrument as well, incorporates relative safety importance factors (RSIF's) and calculates safety need indexes (SNI's). Therefore, a computer program that will incorporate all pertinent formulas should be designed for use along with these assessments.

The use of the improved instrument as described above, resulting from the validation of the methodology designed and tested in this research is strongly recommended for future assessments of safety conditions in the agriscience laboratories. This new instrument is shown in Fig.6.2.

RECOMMENDED INSTRUMENT

For safety assessments in agriscience laboratories

RSIF = Relative safety need index
NA = Non applicable
N = non existent
SCALE = One to ten ascending
SNI = Safety need index

NAME OF SCHOOL:	LAB. SIZE:
PARISH:	STUDENTS PER LAB.:
INSTRUCTOR (S):	SQ. FT. PER STUDENT:
SCHOOL POPULATION:	DATE:

N°	SECTORS AND ITEMS	1 RSIF	2 NA	3 N	4 Scale	5 SNI
	BUILDING					
1	General appearance is conducive to student safety					
2	Floors are kept in a condition conducive to student safety					
3	Walls and ceilings are kept in a condition conducive to student safety					
4	The facilities are free from evident architectural barriers					
5	There are sufficient exits in each laboratory					
6	Storage space for tools and materials is adequate					
7	Storage space for equipment and materials being worked on is adequate					
8	The facilities are wheelchair accessible (including laboratories)					
		Sector				
	ENVIRONMENT					
9	Facilities are pleasant & conducive to student safety					
10	Facilities are clean and orderly					
11	The area or square feet of laboratory per student is adequate					
12	Illumination is sufficient and non glare lighting is provided for all work areas					
13	Ventilation is adequate and proper for conditions					
14	Air is free from dust, smoke, or other contaminants					
		Sector				
	MACHINES & EQUIPMENT					
15	General arrangement conforms to good safety practices					
16	All stationary machines are securely fastened in place					
17	Machines are located for required process compatibility					
18	Auxiliary equipment is orderly and readily available					
19	Work stations are designed to prevent hazards from excess heat or noise					
20	Work stations are designed to prevent hazards from fire or fumes					
21	Work stations are designed to prevent hazards from other machines					
22	Parts of machines needing special caution are color coded					
23	All machines guards are in proper position for safe machine operation					
24	Jointer knives are equipped with left and right guards					
25	Abrasive wheels are equipped with safety eye shields					
26	Abrasive wheels are equipped with tool rests					
27	Abrasive wheels are equipped with guards					
28	Table saws are equipped with guards and anti-kickback system					
29	Radial saws are guarded and equipped with anti-kickback device					
30	Radial saws are equipped with forward stop and positive saw return					
31	Machine belts and pulleys are equipped with guards					
32	Torches and regulators are in good operating condition					
33	Hoses are maintained in good condition					
34	Anti (fire) flashbacks are installed where required in all hoses and lines					
35	Welding arcs cannot strike cylinders, gas or water lines					
36	Electrode holders are maintained and stored in good condition					

(Fig. 6.2 con'd)

Fig. 6.2 Recommended Improved Instrument

		RSF	NA	N	Scale	SNI
37	Proper ventilation is provided in welding areas					
38	All hand-held power tools are equipped with a "dead man" switch					
39	All electrical apparatus in areas of concentrated vapors are vapor proof					
40	All hoisting devices are in safe operating condition					
		Sector				

SAFETY CONDITIONS

41	Nonskid surfaces are provided around machines					
42	All welding is done in screened areas					
43	Cylinders are secured upright and stored in ventilated and clear areas					
44	Danger zones are properly identified and guarded					
45	Aisles are clear of protruding objects					
46	Electrical outlets and circuits are properly identified					
47	Exits are adequately and properly identified					
48	Walls are clear of hanging objects that might fall					
49	Utility lines are properly located and identified					
50	A master power switch panel controls all electrical outlets					
51	Individual machine power switches are installed in power panels					
52	Extension cords are in good condition (not spliced)					
53	Extension cords have three-way grounded plugs					
54	Cables are routed so that they are accessible for inspection and repair					
55	All switches are enclosed					
56	No temporary wiring is evident					
57	The laboratory has eye wash bottles					
58	The laboratory has chemical spill kits					
59	The laboratory has safety showers					
60	An adequately stocked first aid cabinet is provided					
		Sector				

HOUSEKEEPING

61	Good housekeeping practices are evident					
62	Benches are kept orderly					
63	Corners and dead spots are clean and clear					
64	Special tool racks are in orderly condition at bench and machine sites					
65	Tools, supplies, and/or materials are orderly					
66	Sufficient scrap boxes are provided					
67	Materials are stored in an orderly and safe condition					
		Sector				

ERGONOMICS AND SAFETY ENGINEERING

68	Room furniture and equipment are arranged to avoid accidents					
69	Aisles are properly located for efficient performance					
70	The tasks required from students are human factors compatible					
71	Dials, controls and displays conform to human factors standards					
72	There is local or direct lighting for equipment where needed					
73	The work areas are free from direct or reflected glare sources					
74	The work areas are free from evident sharp edges or trip hazards					
75	The work areas are free from evident slip and fall hazards					
76	Tool racks are available where needed					
77	Areas for teaching and demonstration are available					
78	Work stations are designed to prevent hazards from passing students					
79	Work stations are designed to protect observing students from hazards					
80	Safety instructions for use of each machine are posted or readily available					
81	All machine switches are within easy reach of the operators					
82	A visible "off" position is located on each machine					
83	Machines are located in such way that operator space is adequate					
84	Machines are located in such a way that required supervision is possible					
85	Master and other power panels are easily accessible					
		Sector				

SCHOOL SAFETY POLICIES & PROCEDURES

		RSF	NA	N	Scale	SNI
86	A safety policy or rules are enforced for safe shop operation					
87	Number of laboratory groups are kept appropriate for the respective work stations					
88	Laboratory areas are provided with custodial services					
89	The school uses the services of a safety inspector or advisor					
90	The school promotes and organizes safety contests					
91	Emergency procedures have been established for emptying the facilities					
92	All safety procedures are posted conspicuously near all areas of operation					
93	The school has access to qualified individuals to administer first aid					
94	Instructors are First Aid certified					
95	The school has a policy and/or procedure for the administration of first aid					
					Sector	

GENERAL SAFETY PRACTICES

96	Routine preventative maintenance is practiced					
97	All maintenance problems and requests for improvement are recorded					
98	Facilities are inspected regularly for hazards and needed corrections					
99	An inspection checklist is used when making the above inspections					
100	All defective equipment and hazards are reported immediately					
101	Records of all inspections are readily available for reference					
102	Safety inspections of the shop are also made by a student safety committee					
103	Students are rotated on the student safety committee					
104	Lockers are inspected regularly for cleanliness and fire hazards					
105	Locker doors are kept closed					
106	One instructor has the overall responsibility for each major facility					
107	Instructor supervision is provided at all times during laboratory sessions					
108	All main power switches are " off " when laboratories are not in session					
109	All machines are shut off when the instructor is out of the laboratory					
110	All machines are shut off while unattended					
111	All machines are off and tagged when being cleaned or adjusted					
112	Continuous proper examples are practiced by the instructor					
113	All accidents are reported for immediate attention and analysis					
114	All accident analyses are used to implement prompt corrective measures					
115	Activities are selected based on students' ability & maturation level					
116	Machine operation instructions are posted or available near areas of operation					
117	Tools are kept sharp, clean, and in safe working order					
118	Materials being worked are secured when the operation so demands					
119	All work undertaken is approved through an established method					
120	Proper warnings are given in using toxins, caustics and volatile materials					
121	The school promotes and develops the sense of safety consciousness					
122	Questions on safety are included in the instructional program					
123	Printed safety rules are given to each student					
124	Motion and/or slide films on safety are used in the instruction					
125	Occasional talks on safety are given by industry or outside specialists					
126	Students that constantly violate safety regulations are removed from class					
127	Dangerous horseplay and practical jokes are prohibited					
128	A proper record is kept of safety instruction given					
129	Inappropriate garments or other materials are kept out of activity areas					
130	Safety bulletin boards and posters are part of the total safety program					
131	Only spark lighters are used to light torches					
132	Safety cans are provided for storing flammable liquids					
133	Students are tested for safety knowledge					
134	Students are tested for safety ability					
135	Students are instructed in methods for handling and lifting materials					
136	Students are instructed to clear off machines before turning them on					
137	Students are instructed never to leave a machine while it is in operation					
138	Students are instructed never to stop moving parts of a machine by hand					
139	Students are instructed to stay clear of other operating machines					
140	Students are instructed not to annoy or alarm an operator					
141	Students are instructed in the use of the tools and equipment they operate					
142	Students are tested and authorized before operating machines					
143	Students are alerted and monitored for possible hazardous operations					
144	Students are instructed as to how to report hazards and fires					
145	Students sleeves are rolled above elbows when operating machines					

		RSIF	NA	N	Scale	SNI
146	Students avoid the use of loose clothing, jewelry, ties, long hair, etc.					
147	The students are not exposed to unreasonable environmental changes					
148	Noise from laboratory or other sources do not annoy or distract students					
149	Scrap stock is promptly put in scrap boxes					
150	Containers for oily rags are frequently emptied					
151	Waste (shavings, sawdust, paint, etc.) is disposed of daily					
152	Machines are kept in safe operating condition at all times					
153	Temperature control for all seasons is adequate					
154	Noise is always kept within acceptable levels at all laboratory locations					
155	Proper tools and materials are always available for machine cleaning					
156	All guards are used at all times					
157	Signs are always secured to machines that are out of order					
158	Power panel switches are always "off" when machines are out of order					
159	Compressed air is always reduced to 30 psi when used for cleaning					
160	Compressed air is always provided with proper tip when used for cleaning					
161	Extension cords are always avoided as permanent installations					
162	Arc welding is always done only in dry areas					
163	Welding is always done only in areas free of combustible materials					
164	Fire proof bulk storage is provided outside the facilities					
165	All waste and oily rags are always placed in the correct containers					
166	Noise levels never affect speech intelligibility or present a health hazard					
167	There are not unusual human factors incompatibilities for working students					
168	Reflective screens are always used as protection from arc flashes and burns					
169	The laboratory keeps an inventory of all chemicals used					
170	The laboratory uses materials safety handling sheets					
171	The instructors are certified in handling chemicals					
172	The instructor (s) has (have) 40 hour hazardous waste training					
173	The laboratory is inspected for safety on a monthly basis					
174	The laboratory has procedures for dealing with chemical spills					
175	The laboratory has a planned response for chemical spills					
				Sector		

PERSONAL PROTECTIVE EQUIPMENT

176	Personal protective equipment is washed and disinfected as needed					
177	Provisions are made for cleaning and disinfecting of respirators					
178	Eye-wash baths and showers are available when using caustic materials					
179	Eye-protective devices are disinfected & returned to proper racks after use					
180	Observers use acceptable protection					
181	Protective clothing (aprons, shoes, gloves, etc.) are used when required					
182	Respiration and noise suppression devices are used as required					
183	Eye protection devices are worn when required					
184	Shields are provided for electric welding					
185	Goggles with the proper lenses are used when torch welding					
186	An arc-welding helmet with correct lenses is used when electric welding					
				Sector		

FIRE PREVENTION

187	Sufficient fire extinguishers are available					
188	Fire extinguishers are of the proper type					
189	Fire extinguishers are adequately located, maintained and supplied					
190	The laboratory has fire detectors					
191	Spray room doors swing out and cannot be locked from the inside					
192	Storage and waste containers are fire-proof					
193	Wash tanks for parts that use solvents are fire proof					
194	Fire proof storage cabinets are provided for all flammable liquids					
195	Instructors are knowledgeable in the use of the fire extinguishers					
196	Instructors know the procedures in the event of fire					
197	Filters in spray booths are replaced regularly					
198	Students know the location and use of the various fire extinguishers					
199	Students are instructed on the basics of fire prevention					
200	Students are instructed as to how to report fires					
				Sector		
	School					

REFERENCES

American Chemical Society, 1979, Safety in Academic Chemistry Laboratories. Washington, D. C. American Chemical Society.

Anton, Thomas J., 1979, Occupational Safety and Health Management. McGraw Hill Book Company.

Bear, W. R., & Hoerner, T. A., 1980, Planning, organizing, and teaching agricultural mechanics. St. Paul, MN: Hobar Publications.

Brown, R. A., 1977, More responsibility for teachers and teacher educators. The Journal of the American Association of Teacher Educators in Agriculture, 18(2), 9-13.

Brown, Robert D., 1979, Industrial education facilities. A handbook for organization and management. Boston, MA. Allyn and Bacon, Inc.

Bruening, T. H., Hoover, T. S., & Radhakrishna, R. B., 1991, Improving safety practices in agricultural mechanics laboratories. Proceedings of the 18th Annual National Agricultural Education Research Meeting. Los Angeles, CA.

Burke, S. R., 1989, Accidents in Virginia secondary agricultural programs. Proceedings of the 38th Southern Agricultural Education Research Conference. Jackson, MS.

Cassetto, James M. and Pedras, Melvin J., 1986, Safety in Idaho, A guide for practice. State Division of Vocational Education. Idaho State Department of Education. Boise, Idaho.

Connecticut State Department of Children and Youth Services, Connecticut State Department of Education and Connecticut State Department of Health Services, 1986, Providing Emergency Medical Care to Students in Public Schools. Hartford, CT. Connecticut Advisory School Health Council.

Cook, G. C.., Walker, C., & Snowden, O. L., 1952, Practical methods in teaching farm mechanics. Danville, IL. The Interstate.

Daniels, J. H., 1980, Safety: A reverent responsibility. The Agricultural Education Magazine, 53 (3,4).

Dean, Robert; Dean, Melanie Messer & LaMoine L. Motz, 1978, Safety in the Secondary Classroom. NSTA Subcommittee on Safety, National Science Teachers Association. Washington, D.C.

Dennis, William H., 1992, General safety and health manual for technical, vocational and technology education programs. Bulletin No. 1674. Louisiana Department of Education.

Dyrenfurth, Michael J. & Linhardt, Richard E., 1981, Vocational Safety Guide to Generalized Safety Provisions as they Apply to agricultural education, business and office education, home economics education, industrial arts education, marketing and distributive education, trade and technical education. Missouri University, Columbia, Division of Career and Adult Education. Dept. of Elementary and Secondary Education.

Elkow, J. Duke, 1970, "Safety Apathy in General" Annual Safety Education Review. American Association for Health, Physical Education, and Recreation. NEA Publications, Washington, D. C.

Firenze, Robert J. & Walters, James B., Safety and Health for Industrial Vocational Education: for supervisors and instructors. National Institute for Occupational Safety and Health (DHHS/PHS) Cincinnati, Ohio. Division of Training and Manpower Development; Occupational Safety and Health, Washington, D. C.

Fletcher, W. E. & Johnson, D. M., 1990, Safety Practices and Equipment Used in Mississippi Secondary Agricultural Mechanics Laboratories. Proceedings of the 17th Annual Agricultural Education Research Meeting. Cincinnati, OH.

Geneen, H., 1984, Managing. Doubleday, New York.

George, Babu & Perkins, Ron, 1987, 10 Steps to a Safer New Year. The Science Teacher. January.

Gliem, J. A., & Hard, D. L., 1988, Safety in vocational agriculture programs. Paper presented at the Winter Meeting of the American Society of Agricultural Engineers. Chicago, IL.

Gliem, J. A., & Miller, G., 1993, Laboratory safety in Vocational Education: An Administrator's perspective. Journal of Agricultural Education. v34n3, pp.26-33.

Godbey, Frank W., 1979, Occupational safety and health: A guide for administrators, faculty, and staff. (Report No. NIOSH-79-13B). Publication # 79-125 Cincinnati, OH. National Institute for Occupational Safety and Health, Division of Technical Services.

Graham, C.D., 1981, Pennsylvania Industrial Arts Safety Guide. Second edition. Harriesburg, PA. Pennsylvania State Department of Education, Bureau of Vocational and Technical Education.

Greene, Brenda Z., 1985, Protect against personal injury to limit your liability. National School Board Association, Alexandria, VA. Educational Policies Service.

Grimaldi, John V. & Simonds, Rollin H., 1989, Safety Management. Richard D. Irwin, Inc., Homewood, IL.

Hammer, Willie, Occupational Safety Management and Engineering. Prentice Hall Inc. Englewoods Cliff, New Jersey.

Hoemer, T. A., & Kessler, K., 1989, Factors related to safety instruction in Iowa secondary agricultural mechanics programs. Paper presented at the 43rd Annual Central States Seminar in Agricultural Agribusiness Education. Chicago, IL.

Idaho State Department of Education. Industrial Arts Safety. Boise City, ID.

Industrial Arts Education, (Purposes, program, facilities, instruction, supervision), 1963, American Council of Industrial Arts Education, a Dept. of the National Education Association.

Johnson, Donald M.. & Fletcher, William E., 1990, An analysis of the agricultural mechanics safety practices of Mississippi secondary agriculture teachers. Proceedings of the thirty-ninth annual Southern Agricultural Education Research Conference. San Antonio, TX.

Johnson, Donald M.. & Schumacher, Leon, G., 1988, Agricultural Mechanics Management Competencies. National Agricultural Research Meeting. St. Louis, MO.

Johnson, J. T., & Mancuso, J. B., 1974, Safety Practices and Procedures in School Shops. New Jersey State Department of Education. Trenton, NJ.

Kavianian, H. R., and Wentz, Jr., C. A., 1990, Occupational and Environmental Engineering and Management. Van Nostran Reinhold, New York.

Kigin, Denis J., 1983, Teacher liability in school shop accidents. Arizona State University. Prakken Publications. Ann Arbor, MI.

Kirk, A. S., 1988, Safety and health. Resource guide for occupational / technology education. Augusta, ME. State Department of Educational and Cultural Services.

Kobylarz, Joseph D. & Olender, Francis B., 1983, New Jersey Industrial Arts Education Safety Guide. Rutgers, The State University, New Brunswick, N. J. Dept. of Vocational-Technical Education.

Laboratory Safety, 1991, U.S. Department of Labor. Mine Safety and Health Administration. National Mine Health and Safety Academy. Safety Manual No. 4S.

La Morte, M. W., 1990, School law cases and concepts. Englewood Cliffs, NJ. Prentice Hall.

Lawver, David E., 1992, An analysis of agricultural mechanics safety practices in Texas agricultural science programs. Department of Agricultural Education and Communications, Texas Tech University. Proceedings of the Nineteenth Annual National Agricultural Education Research Meeting. St. Louis, Missouri.

McMahon, G., 1975, Organizing an effective safety program. In M. E. Strong (Ed.). Accident prevention manual for training programs. (pp.17-28).
Meet The Safety Man, 1968, School Safety. v4n2, Nov. / Dec.
National Safety Council, 1974, Accident Prevention Manual for Industrial Operations (7th ed.). Boston, MA.

National Science Teachers Association, 1986, Safety in the Secondary School Classroom and Laboratory. 2nd ed. Washington, D. C.

New Jersey State Department of Education, Code for School Planning and Construction, 1979, Trenton, Division of Finance and Regulatory Service. Bureau of Facility Planning Services. (N.J.A.C.- G: 22-1 et seq,).

New Mexico State Department of Education, 1975, Vocational - Industrial Safety Guide. Santa Fe, New Mexico.

Ramp, W. S., Johnson, M. E., & McLuckie, J. D., 1975, Planning and maintaining a safe environment for shop students. In M. E. Strong (Ed.) Accident prevention manual for training programs. (pp. 83 - 156). American Technical Society.

Rudolph, J. L., & Dillon, R. D., 1984, A comparison of existing standards found in Nebraska vocational agricultural mechanics laboratories with standards developed on a regional and national level. Proceedings of the 11th Annual National Agricultural Education Research Meeting. New Orleans, LA.

Safety Instruction Manual for Programs in Agricultural Education, 1981, New York State Education Dept., Albany. Bureau of Agricultural Education.

Safety System Design for Technology Education. A Safety Guide for Technology Education, 1990, North Carolina State Department of Public Instruction, Division of Vocational Education Services. Raleigh, NC.

Saving Children: A guide to injury prevention, 1991, Modern Hoover Wilson. New York: Oxford University Press.

Science. A guide to Curriculum Development, 1991, Connecticut State Dept. of Education, Hartford. State of Connecticut Dept. of Education, Curriculum and Instruction.

Shinn, G. C., 1987, September - the time to improve your laboratory teaching. The Agricultural Education Magazine, 59 (1), 8-9.

Shop Safety Education, 1949, Training for accident prevention in the home, in industry and on the farm... by the University of the State of New York. New York (State) Bureau of Vocational Curriculum Development and Industrial Technology Training.

South Carolina State Department of Education, 1981, South Carolina Industrial Arts Safety Guide. Columbia, SC.

State of Ohio, Industrial Arts and Vocational Education Safety Manual. Columbus, OH. State of Ohio, Department of Education, Industrial Commission of Ohio, Division of Safety and Hygiene, n.d.

Strong, Merle E., Ed. 1975, Accident Prevention Manual for Training Programs. Chicago, IL. American Technical Society.

U.S. Department of Health and Human Services; Berberich, NJ, et al. Manual of Safety and Health Hazards in the School Science Laboratory. Lancaster, VA. Council of State Science Supervisors, 1984.

U. S. Department of Labor, Occupational Safety and Health Administration. All About OSHA, 1976, OSHA 2056, Washington, D.C.

U. S. Congress, 1970, Occupational Safety and Health Act of 1970. Public Law 91-596. 91st Congress.

Wahl, Ray, 1977, Safety and Health Guide for Vocational Educators. Vol 15, No 1, Harriesburg, PA. Pennsylvania State Department of Education.

Washington State Industrial Arts Safety Guide, 1976, Olympia, WA. State of Washington Department of Education.

Williams, William A., 1975, A check list of preferred safety practices for school shops. In M. E. Strong (Ed.). Accident prevention manual for training programs, (pp.50-82). American Technical Society.

Williams, William A., 1963, Accident Prevention Manual For Shop Teachers. A Professional Publication of the National Association of Industrial Teacher Educators. American Technical Society. Chicago 1963.

Woods, Margaret S., 1970, On Feeling Safe in Your Mind. School Safety, v5n4, March / April.

Zirbes, Laura, 1968, How Shall We Teach Them Safety. School Safety, v4n3 Jan. / Feb.

APPENDIX A
HYPOTHESIZED SURVEY MODEL

HYPOTHESIZED SURVEY MODEL (HSM)
(Preliminary Instrument for Research)

To be tested and validated at the agriscience laboratories of four high schools in South Central Louisiana

A METHODOLOGY TO ASSESS SAFETY CONDITIONS IN LOUISIANA AGRISCIENCE LABORATORIES

By Julio A. Meléndez

ALL ITEMS WILL BE RATED, CLASSIFIED OR SCORED

AVAILABLE

Yes No N/A

IF AVAILABLE

Is(Are) it (they) of the proper type

Is (Are) it (they) properly located

CONDITIONS

Excellent Satisfactory Poor Bad

SPECIFIC COMMENTS

(Appendix A con'd)

I. **BUILDING**

- floors
- walls — clear of objects that may fall
- windows
- ceilings
- exits — number and location
- general appearance — orderliness
- storage space for tools and materials
- storage space for equipment or materials being worked on
- teaching or demonstration area
- designated safety zone areas are provided around all areas of work

II. **ENVIRONMENT**

- illumination — sufficient/well placed — candles
- temperature control
- ventilation — adequate
- air (free from dust, smoke, etc.)
- noise level
- area of laboratory — approx._____sq. ft.
- max. number of students per lab session — _____

III. **ARRANGEMENT**

- machines — other machines/passing students
- small equipment
- benches
- aisles
- utility lines — properly identified and located
- tool racks
- non-skid areas around machines
- danger zones — properly indicated
- auxiliary equipment

(Appendix A con'd)

IV. **AUXILIARY EQUIPMENT**

- fire extinguishers — type/location/maintenance
- student lockers
- scrap boxes — sufficient
- spring lid metal container for waste or oily rags

V. **GENERAL SAFETY PROCEDURES**

- procedures for emptying rooms
- procedures for fire evacuation, etc.

VI. **BASIC SAFETY CONDITIONS OR PRACTICES**

- locker doors kept closed
- scrap stock put in scrap boxes promptly
- container for waste and oily rags frequently and regularly emptied
- dangerous materials stored in metal cabinets
- flammable liquids stored in safety cans
- flammable liquids stored properly
- flammable liquids properly handled when in use
- flammable liquids not used for cleaning purposes
- bulk storage of dangerous materials outside main building
- brushes used for cleaning equipment
- adequate teacher supervision is maintained
- machines are shut off while unattended
- all machines are locked off when instructor is out of the room
- tools kept sharp, clean and in safe working conditions
- safety guards are properly located where needed
- all equipment control switches are available to operator
- hoisting devices are in safe working conditions
- materials stored orderly and safely
- machines are color conditioned
- all switches are enclosed

(Appendix A con'd)

- there is a master control switch for all electrical installations
- electrical outlets and circuits are properly identified
- all electrical extension cords are in safe conditions and not carrying excessive loads
- no temporary wiring in evidence.

VII. MACHINE/EQUIPMENT SPECIFICS

- general safe working conditions
- color code
- all gears, moving belts, etc. are protected by permanent enclosure guards
- machines are guarded to comply with American Standard Association
- all machine switches are within easy reach of the operator
- electrical motors and equipment wired to comply with the National Electric Code
- individual cutoff switches provided for each machine
- machines provided with overload and underload controls by magnetic push-button controls
- no temporary wiring in evidence.

VIII. HOUSEKEEPING

- floors cleaned regularly
- floors free of oil, water, foreign materials
- walls, windows, ceilings cleaned periodically
- corners and dead spots clean and cleard
- benches kept orderly
- orderly tool and/or materials supply
- trash and remains disposed off promptly

IX. PERSONAL PROTECTION

- goggles or protective shields are provided and required for all work where eye hazards exist
- if individual goggles are not provided, hoods and goggles are properly disinfected before use
- shields and goggles are provided for electric welding
- rings and other jewelry are removed by students when working in the shop
- proper kind of wearing apparel is worn and worn properly for the job being done
- leggings, safety shoes, etc., are worn in special classes such as foundry, etc. when needed
- respirators are provided for dusty or toxic atmospheric conditions such as when spraying in the finishing room
- provisions are made for cleaning and sterilizing respirators
- students are examined for safety knowledge ability
- sleeves are rolled above elbows when operating machines

- students are examined for safety knowledge ability
- sleeves are rolled above elbows when operating machines
- clothing of student is free from loose sleeves, ties, loose coats, etc.[1]

X. **FIRST AID**

- an adequately socked firs aid cabinet is provided
- the first aid is administered by a qualified individual
- the schools has individuals qualified to administer first aid

XI. **SAFETY INSTRUCTION**

- shop safety is taught as an integral part of each teaching unit
- safety rules are posted particularly at each danger station
- printed safety rules are given each student
- pupils take a safety pledge
- use of a safety inspector
- use of student shop safety committee
- use of safety contests
- motion and/or slide films on safety are used in the instruction
- use of suggestion box
- use of safety tests
- use of safety posters
- talks on safety are given to the classes by industrial men
- tours are taken of industrial plants as means of studying safely practices
- periodic safety inspections of the shop are made by a student committee
- men from industry make safety inspections of the shop
- student shop safety committee investigates all accidents
- a proper record is kept of safety instructions which are given, preferable showing the signature of student on tests given in this area
- rotate students on the shop safety committee so that as many students as possible have an opportunity to participate

APPENDIX B
RESEARCH SURVEY MODEL

Part 1-a

LOUISIANA STATE UNIVERSITY
COLLEGE OF ENGINEERING

A METHODOLOGY TO ASSESS SAFETY CONDITIONS OF S. E. LOUISIANA AGRISCIENCE LABORATORIES

By JULIO A. MELÉNDEZ

NAME OF SCHOOL:	LAB. SIZE:
PARISH:	STUDENTS PER LAB.:
INSTRUCTOR (S):	SQ. FT. PER STUDENT
SCHOOL POPULATION:	DATE VISITED:

N°	ERGONOMIC AND SAFETY ASSESSMENT	1 NA	2 N	3 Scale
	BUILDING			
1	General appearance is conducive to student safety			
2	Floors are kept in a condition conducive to student safety			
3	Walls and ceilings are kept in a condition conducive to student safety			
4	The facilities are free from evident architectural barriers			
5	There are sufficient exits in each laboratory			
6	Storage space for tools and materials is adequate			
7	Storage space for equipment and materials being worked on is adequate			
8	Stairways have safe treads and risers			
9	Stairways have approved railings			
10	Mezzanines are protected with toe boards or railings			
11	The facilities are wheelchair accessible (including laboratories)			
	ENVIRONMENT			
12	Facilities are pleasant & conducive to student safety			
13	Facilities are clean and orderly			
14	The area or square feet of laboratory per student is adequate			
15	Illumination is sufficient and non glare lighting is provided for all work areas			
16	Ventilation is adequate and proper for conditions			
17	Air is free from dust, smoke, or other contaminants			
	MACHINES & EQUIPMENT			
18	General arrangement conforms to good safety practices			
19	All stationary machines are securely fastened in place			
20	Machines are located for required process compatibility			
21	Auxiliary equipment is orderly and readily available			
22	Work stations are designed to prevent hazards from excess heat or noise			
23	Work stations are designed to prevent hazards from fire or fumes			

(Appendix B con'd)

N = Non applicable, N = non existent, Scale : 1 - 10 ascending

RSM - Part 1

Part 1-b

		NA	N	Scale
24	Work stations are designed to prevent hazards from other machines			
25	Parts of machines needing special caution are color coded			
26	All machines guards are in proper position for safe machine operation			
27	Squaring shears are equipped with finger guards			
28	Squaring shears are equipped with foot treadle stops			
29	Jointer knives are equipped with left and right guards			
30	Abrasive wheels are equipped with safety eye shields			
31	Abrasive wheels are equipped with tool rests			
32	Abrasive wheels are equipped with guards			
33	Table saws are equipped with guards and anti-kickback system			
34	Radial saws are guarded and equipped with anti-kickback device			
35	Radial saws are equipped with forward stop and positive saw return			
36	Machine belts and pulleys are equipped with guards			
37	Piped welding systems have back pressure valves in both lines			
38	Piped welding systems have no quick opening shut off valves			
39	Torches and regulators are in good operating condition			
40	Hoses are maintained in good condition			
41	Anti (fire) flashbacks are installed where required in all hoses and lines			
42	Welding arcs cannot strike cylinders, gas or water lines			
43	Electrode holders are maintained and stored in good condition			
44	Proper ventilation is provided in welding areas			
45	All hand-held power tools are equipped with a "dead man" switch			
46	All electrical apparatus in areas of concentrated vapors are vapor proof			
47	All hoisting devices are in safe operating condition			

SAFETY CONDITIONS

48	Nonskid surfaces are provided around machines			
49	All welding is done in screened areas			
50	Cylinders are secured upright and stored in ventilated and clear areas			
51	Danger zones are properly identified and guarded			
52	Aisles are clear of protruding objects			
53	Stairways have unobstructed access			
54	Railings are color coded			
55	Stairways are color coded			
56	Electrical outlets and circuits are properly identified			
57	Exits are adequately and properly identified			
58	Walls are clear of hanging objects that might fall			
59	Utility lines are properly located and identified			
60	A master power switch panel controls all electrical outlets			
61	Individual machine power switches are installed in power panels			
62	Extension cords are in good condition (not spliced)			
63	Extension cords have three-way grounded plugs			
64	Cables are routed so that they are accessible for inspection and repair			
65	All switches are enclosed			
66	No temporary wiring is evident			
67	The laboratory has eye wash bottles			

(Appendix B con'd)

Part 1-c

		NA	N	Scale
68	The laboratory has chemical spill kits			
69	The laboratory has safety showers			
70	An adequately stocked first aid cabinet is provided			

HOUSEKEEPING

		NA	N	Scale
71	Good housekeeping practices are evident			
72	Benches are kept orderly			
73	Corners and dead spots are clean and clear			
74	Special tool racks are in orderly condition at bench and machine sites			
75	Tools, supplies, and/or materials are orderly			
76	Sufficient scrap boxes are provided			
77	Materials are stored in an orderly and safe condition			

FIRE PROTECTION

78	Sufficient fire extinguishers are available			
79	Fire extinguishers are of the proper type			
80	Fire extinguishers are adequately located, maintained and supplied			
81	The laboratory has fire detectors			
82	Spray room doors swing out and cannot be locked from the inside			
83	Storage and waste containers are fire-proof			
84	Wash tanks for parts that use solvents are fire proof			
85	Fire proof storage cabinets are provided for all flammable liquids			

ERGONOMICS AND SAFETY ENGINEERING

86	Room furniture and equipment are arranged to avoid accidents			
87	Aisles are properly located for efficient performance			
88	The tasks required from students are human factors compatible			
89	Dials, controls and displays conform to human factors standards			
90	There is local or direct lighting for equipment where needed			
91	The work areas are free from direct or reflected glare sources			
92	The work areas are free from evident sharp edges or trip hazards			
93	The work areas are free from evident slip and fall hazards			
94	Tool racks are available where needed			
95	Areas for teaching and demonstration are available			
96	Work stations are designed to prevent hazards from passing students			
97	Work stations are designed to protect observing students from hazards			
98	Safety instructions for use of each machine are posted or readily available			
99	All machine switches are within easy reach of the operators			
100	A visible "off" position is located on each machine			
101	Machines are located in such way that operator space is adequate			
102	Machines are located in such a way that required supervision is possible			
103	Master and other power panels are easily accessible			

(Appendix B con'd)

Part 2-a

LOUISIANA STATE UNIVERSITY
COLLEGE OF ENGINEERING

A METHODOLOGY TO ASSESS SAFETY CONDITIONS OF S. E. LOUISIANA AGRISCIENCE LABORATORIES

BY JULIO A. MELÉNDEZ

NAME OF SCHOOL:	SCHOOL POPULATION:
PARISH:	STUDENTS PER LAB.:
INSTRUCTOR (S):	DATE VISITED:

		1	2	3
N°	QUESTIONNAIRE FOR THE TEACHERS	N/A	N	Scale
	SCHOOL SAFETY POLICIES & PROCEDURES			
1	A safety policy or rules are enforced for safe shop operation			
2	Number of laboratory groups are kept appropriate for the respective work stations			
3	Laboratory areas are provided with custodial services			
4	The school uses the services of a safety inspector or advisor			
5	The school promotes and organizes safety contests			
6	Emergency procedures have been established for emptying the facilities			
7	All safety procedures are posted conspicuously near all areas of operation			
8	The school has access to qualified individuals to administer first aid			
9	Instructors are First Aid certified			
10	The school has a policy and/or procedure for the administration of first aid			
	GENERAL SAFETY PRACTICES			
11	Routine preventative maintenance is practiced			
12	All maintenance problems and requests for improvement are recorded			
13	Facilities are inspected regularly for hazards and needed corrections			
14	An inspection checklist is used when making the above inspections			
15	All defective equipment and hazards are reported immediately			
16	Records of all inspections are readily available for reference			
17	Safety inspections of the shop are also made by a student safety committee			
18	Students are rotated on the student safety committee			
19	Lockers are inspected regularly for cleanliness and fire hazards			
20	Locker doors are kept closed			
21	One instructor has the overall responsibility for each major facility			
22	Instructor supervision is provided at all times during laboratory sessions			
23	All main power switches are " off " when laboratories are not in session			
24	All machines are shut off when the instructor is out of the laboratory			
25	All machines are shut off while unattended			

(Appendix B con'd)

Part 2-b

N°	QUESTIONNAIRE FOR THE TEACHERS	N/A	N	Scale
26	All machines are off and tagged when being cleaned or adjusted			
27	Continuous proper examples are practiced by the instructor			
28	All accidents are reported for immediate attention and analysis			
29	All accident analyses are used to implement prompt corrective measures			
30	Activities are selected based on students' ability & maturation level			
31	Machine operation instructions are posted or available near areas of operation			
32	Tools are kept sharp, clean, and in safe working order			
33	Materials being worked are secured when the operation so demands			
34	All work undertaken is approved through an established method			
35	Proper warnings are given in using toxics, caustics and volatile materials			
36	The school promotes and develops the sense of safety consciousness			
37	Questions on safety are included in the instructional program			
38	Printed safety rules are given to each student			
39	Motion and/or slide films on safety are used in the instruction			
40	Occasional talks on safety are given by industry or outside specialists			
41	Students that constantly violate safety regulations are removed from class			
42	Dangerous horseplay and practical jokes are prohibited			
43	A proper record is kept of safety instruction given			
44	Inappropriate garments or other materials are kept out of activity areas			
45	Safety bulletin boards and posters are part of the total safety program			
46	Only spark lighters are used to light torches			
47	Safety cans are provided for storing flammable liquids			
48	Students are tested for safety knowledge			
49	Students are tested for safety ability			
50	Students are instructed in methods for handling and lifting materials			
51	Students are instructed to clear off machines before turning them on			
52	Students are instructed never to leave a machine while it is in operation			
53	Students are instructed never to stop moving parts of a machine by hand			
54	Students are instructed to stay clear of other operating machines			
55	Students are instructed not to annoy or alarm an operator			
56	Students are instructed in the use of the tools and equipment they operate			
57	Students are tested and authorized before operating machines			
58	Students are alerted and monitored for possible hazardous operations			
59	Students are instructed as to how to report hazards and fires			
60	Students sleeves are rolled above elbows when operating machines			
61	Students avoid the use of loose clothing, jewelry, ties, long hair, etc.			
62	The students are not exposed to unreasonable environmental changes			
63	Noise from laboratory or other sources do not annoy or distract students			
64	Scrap stock is promptly put in scrap boxes			
65	Containers for oily rags are frequently emptied			
66	Waste (shavings, sawdust, paint, etc.) is disposed of daily			
67	Machines are kept in safe operating condition at all times			
68	Temperature control for all seasons is adequate			
69	Noise is always kept within acceptable levels at all laboratory locations			

(Appendix B con'd)

NA = Non applicable, N = non existent, Scale = 1 - 10 ascending

RSM - Part 2

Part 2-c

N°	QUESTIONNAIRE FOR THE TEACHERS	N/A	N	Scale
70	Proper tools and materials are always available for machine cleaning			
71	All guards are used at all times			
72	Signs are always secured to machines that are out of order			
73	Power panel switches are always "off" when machines are out of order			
74	Compressed air is always reduced to 30 psi when used for cleaning			
75	Compressed air is always provided with proper tip when used for cleaning			
76	Extension cords are always avoided as permanent installations			
77	Arc welding is always done only in dry areas			
78	Welding is always done only in areas free of combustible materials			
79	Fire proof bulk storage is provided outside the facilities			
80	All waste and oily rags are always placed in the correct containers			
81	Noise levels never affect speech intelligibility or present a health hazard			
82	There are not unusual human factors incompatibilities for working students			
83	Reflective screens are always used as protection from arc flashes and burns			
84	The laboratory keeps an inventory of all chemicals used			
85	The laboratory uses materials safety handling sheets			
86	The instructors are certified in handling chemicals			
87	The instructor (s) has (have) 40 hour hazardous waste training			
88	The laboratory is inspected for safety on a monthly basis			
89	The laboratory has procedures for dealing with chemical spills			
90	The laboratory has a planned response for chemical spills			

PERSONAL PROTECTIVE EQUIPMENT

91	Personal protective equipment is washed and disinfected as needed			
92	Provisions are made for cleaning and disinfecting of respirators			
93	Eye-wash baths and showers are available when using caustic materials			
94	Eye-protective devices are disinfected & returned to proper racks after use			
95	Observers use acceptable protection			
96	Protective clothing (aprons, shoes, gloves, etc.) are used when required			
97	Respiration and noise suppression devices are used as required			
98	Eye protection devices are worn when required			
99	Shields are provided for electric welding			
100	Goggles with the proper lenses are used when torch welding			
101	An arc-welding helmet with correct lenses is used when electric welding			

FIRE PROTECTION

102	Instructors are knowledgeable in the use of the fire extinguishers			
103	Instructors know the procedures in the event of fire			
104	Filters in spray booths are replaced regularly			
105	Students know the location and use of the various fire extinguishers			
106	Students are instructed on the basics of fire prevention			
107	Students are instructed as to how to report fires			

APPENDIX D
FIELD DATA

FIELD DATA 1

	Items	School #																	
		1		2		3		4		5		6		7		8		9	
	BUILDING																		
1	General appearance is conducive to student safety	5		6		6		7		8		7		6		3		7	
2	Floors are kept in a condition conducive to student safety	10		8		8		7		9		9		8		5		7	
3	Walls and ceilings are kept in a condition conducive to student safety	10		10		8		7		10		4		6		3		9	
4	The facilities are free from evident architectural barriers	10		7		9		10		10		10		4		10		10	
5	There are sufficient exits in each laboratory	5		10		10		10		10		10		10		10		10	
6	Storage space for tools and materials is adequate	10		8		7		5		10		2		2		10		0	
7	Storage space for equipment and materials being worked on is adequate	8		8		8		5		10		2		10		6		6	
8	Stairways have safe treads and risers		1	6		8			1		1	2			1		1		1
9	Stairways have approved railings		1	7		8			1		1	8			1		1		1
10	Mezzanines are protected with toe boards or railings		1	10			1		1		1		1		1		1		1
11	The facilities are wheelchair accessible (including laboratories)	10		0		8		10		10		10		10		0		0	
	TOTALS	68	3	80	0	80	1	61	3	77	3	64	1	56	3	47	3	49	3
	ENVIRONMENT																		
12	Facilities are pleasant & conducive to student safety	10		10		8		7		7		8		6		4		9	
13	Facilities are clean and orderly	6		10		6		7		8		8		10		3		8	
14	The area or square feet of laboratory per student is adequate	5		10		7		2		10		2		4		2		0	
15	Illumination is sufficient and non glare lighting is provided for all work area	5		10		6		10		10		6		4		10		7	
16	Ventilation is adequate and proper for conditions	3		10		6		10		10		10		2		2		8	
17	Air is free from dust, smoke, or other contaminants	5		10		6		8		9		9		2		3		10	
	TOTALS	34	0	60	0	39	0	44	0	54	0	43	0	28	0	24	0	42	0
	MACHINES AND EQUIPMENT																		
18	General arrangement conforms to good safety practices	10		9		8		10		8		8		6		8		7	
19	All stationary machines are securely fastened in place	10		0		10			1	8			1	6		0		0	
20	Machines are located for required process compatibility	10		10		6		10		7		10		8		7		8	
21	Auxiliary equipment is orderly and readily available	10		10		7		10		10		10		6		6		8	
22	Work stations are designed to prevent hazards from excess heat or noise	2		10		7		8		10		8		6		10		10	
23	Work stations are designed to prevent hazards from fire or fumes	10		10		8		8		10		8		6		6		10	
24	Work stations are designed to prevent hazards from other machines	10		10		8		8		9		8		6		7		10	
25	Parts of machines needing special caution are color coded	10		0		6		7		0			1		1	3		0	
26	All machines guards are in proper position for safe machine operation	9		10		8		9		8		10			1	0		10	
27	Squaring shears are equipped with finger guards		1		1		1		1		1		1		1		1		1
28	Squaring shears are equipped with foot treadle stops		1		1		1		1		1		1		1		1		1
29	Jointer knives are equipped with left and right guards	10			1		1		1		1		1		1		1		1
30	Abrasive wheels are equipped with safety eye shields	10		10		8		10		5			1		1	0			1
31	Abrasive wheels are equipped with tool rests	10		10		8		9		10			1		1	0			1
32	Abrasive wheels are equipped with guards	10		10		5		10		5			1		1	0			1
33	Table saws are equipped with guards and anti-kickback system	10		10			1	5		10			1		1	0		10	
34	Radial saws are guarded and equipped with anti-kickback device	10		10			1	10		5			1		1	10		10	

First column of each school = Field Safety Rating
Second column of each school = Non Applicables

FIELD DATA

	Items	School #																	
		1		2		3		4		5		6		7		8		9	
35	Radial saws are equipped with forward stop and positive saw return	10		10			1	10		10			1		1	10		10	
36	Machine belts and pulleys are equipped with guards	10		10		8		10			1		1		1	9		0	
37	Piped welding systems have back pressure valves in both lines		1		1		1		1		1		1		1		1		1
38	Piped welding systems have no quick opening shut off valves		1		1		1		1		1		1		1		1		1
39	Torches and regulators are in good operating condition	10		10		6		10		10			1	6		9		10	
40	Hoses are maintained in good condition	10		10		8		9		10			1	6		9		10	
41	Anti (fire) flashbacks are installed where required in all hoses and lines	10		10		7		10		10			1	6		10		10	
42	Welding arcs cannot strike cylinders, gas or water lines	10		10		10		10		10			1	4		9		10	
43	Electrode holders are maintained and stored in good condition	10		10		6		10		10			1	6		4		10	
44	Proper ventilation is provided in welding areas	5		10		8		10		10			1	2		0		10	
45	All hand-held power tools are equipped with a "dead man" switch	10		10		4		0		10			1	6		0		10	
46	All electrical apparatus in areas of concentrated vapors are vapor proof		1		1		1		1		1		1		1		1		1
47	All hoisting devices are in safe operating condition		1		1		1		1	5			1		1		1		1
		227	6	211	7	149	10	197	8	195	7	68	23	87	16	125	7	172	12
	SAFETY CONDITIONS																		
48	Nonskid surfaces are provided around machines	0		0		7		0		0			1	2		0		0	
49	All welding is done in screened areas	10		0		8		10		10			1	0		0		0	
50	Cylinders are secured upright and stored in ventilated and clear areas	0		10		8		10		10			1	6		0		10	
51	Danger zones are properly identified and guarded	10		0		7		10		5			1	6		0		0	
52	Aisles are clear of protruding objects	10		10		8		9		10		1		6		3		10	
53	Stairways have unobstructed access		1	10		8			1		1	10			1		1		1
54	Railings are color coded		1	0		0			1		1	1			1		1		1
55	Stairways are color coded		1	0		0			1		1	1			1		1		1
56	Electrical outlets and circuits are properly identified	0		0		6		10		7		1		10		10		5	
57	Exits are adequately and properly identified	10		0		10		0		10		1		10		10		10	
58	Walls are clear of hanging objects that might fall	10		10		8		10		10		9		10		0		10	
59	Utility lines are properly located and identified		1	10		8			1	10		4		8		10			1
60	A master power switch panel controls all electrical outlets	0		10		0		10		10		10		10		10		10	
61	Individual machine power switches are installed in power panels	0		10		8		10		10			1	10		0		10	
62	Extension cords are in good condition (not spliced)	10		10		10		8		10		10		8		10			1
63	Extension cords have three-way grounded plugs	10		10		10		8		10		10		10		9			1
64	Cables are routed so that they are accessible for inspection and repair		1	10		8		10		10			1	8		10			1
65	All switches are enclosed	10		10		8		10		10		5		10		10		10	
66	No temporary wiring is evident	10		10		10		0		10		10		10		10		10	
67	The laboratory has eye wash bottles	0		10			1	10		0			1	10		0		0	
68	The laboratory has chemical spill kits	0		10			1	0		0			1	0		0		0	
69	The laboratory has safety showers	0		0			1	0		0			1	0		0		0	
70	An adequately stocked first aid cabinet is provided	0		10				5		0		3		0		10		0	
		90	5	150	0	132	3	130	4	142	3	76	9	134	3	102	3	85	7

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(Appendix C con'd)

N°	Items	School #																	
		1		2		3		4		5		6		7		8		9	
	HOUSEKEEPING																		
71	Good housekeeping practices are evident	5		8		2		6		9		8		6		2		8	
72	Benches are kept orderly	5		10		4			1		1		1	6		2		8	
73	Corners and dead spots are clean and clear	5		8		3		3		7		8		6		1		5	
74	Special tool racks are in orderly condition at bench and machine sites		1	8		4			1		1		1	6		7		10	
75	Tools, supplies, and/or materials are orderly	5		10		4		5		8		8		6		5		7	
76	Sufficient scrap boxes are provided	0		10		3			1	10			1	4		2		0	
77	Materials are stored in an orderly and safe condition	5		8		4		5		8		8		6		4			1
		25	1	62	0	24	0	19	3	42	2	32	3	40	0	23	0	38	1
	FIRE PROTECTION																		
78	Sufficient fire extinguishers are available	5		10		10		10		5		8		10		10		10	
79	Fire extinguishers are of the proper type	10		10		10		10		10		10		10		10		10	
80	Fire extinguishers are adequately located, maintained and supplied	5		10		10		10		7		10		10		6		0	
81	The laboratory has fire detectors	0		0		10		0		0		0		0		0		10	
82	Spray room doors swing out and cannot be locked from the inside		1		1		1		1		1		1		1		1		1
83	Storage and waste containers are fire-proof	0		0		8		0		0		0		0		0		0	
84	Wash tanks for parts that use solvents are fire proof		1	10			1		1		1		1		1	10			1
85	Fire proof storage cabinets are provided for all flammable liquids	0		0			1	0			1	0		0		0			1
		20	2	40	1	48	3	30	2	22	3	28	2	30	2	36	1	30	3
	ERGONOMICS AND SAFETY ENGINEERING																		
86	Room furniture and equipment are arranged to avoid accidents	10		10		8		5		7		10		10		6		9	
87	Aisles are properly located for efficient performance	10		10		6		7		9			1	10		6		10	
88	The tasks required from students are human factors compatible	10		10		7		9		8		7		10		7		10	
89	Dials, controls and displays conform to human factors standards	10		7		7		9		8		10		10		8		10	
90	There is local or direct lighting for equipment where needed		1	9		6		8		8			1	0		10		8	
91	The work areas are free from direct or reflected glare sources	10		7		7		10		8		10		6		8		10	
92	The work areas are free from evident sharp edges or trip hazards	10		10		9		8		10		10		8		5		7	
93	The work areas are free from evident slip and fall hazards	8		10		9		5		7		7		6		5		10	
94	Tool racks are available where needed	10		10		8			1	6		8		10		9		0	
95	Areas for teaching and demonstration are available	10		10		8		7		10		8		10		10		10	
96	Work stations are designed to prevent hazards from passing students	6		8		8		7		7		3		6		6		10	
97	Work stations are designed to protect observing students from hazards	10		8		8		7		7			1	4		6		10	
98	Safety instructions for use of each machine are posted or readily available	10		0		8		5		0			1	0		8		5	
99	All machine switches are within easy reach of the operators	10		10		8		8		10			1	10		10		10	
100	A visible "off" position is located on each machine	10		10		8		10		10			1	10		10		10	
101	Machines are located in such way that operator space is adequate	8		8		7		10		10			1	10		9		10	
102	Machines are located in such a way that required supervision is possible	10		10		8		10		9			1	8		9		10	
103	Master and other power panels are easily accessible	0		10		8		0		9			1	10		6		10	
		152	1	157	0	138	0	125	1	143	0	73	9	138	0	138	0	159	0

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N°	Items	School #																	
		1		2		3		4		5		6		7		8		9	
	SCHOOL SAFETY POLICIES AND PROCEDURES																		
104	A safety policy or rules are enforced for safe shop operation	10		10		10		10		10		10		10		10		10	
105	Number of laboratory groups are kept appropriate for the respective work	10			1	10		10		10		0		0		0		10	
106	Laboratory areas are provided with custodial services	0		0		10		0		0		0		0		0		0	
107	The school uses the services of a safety inspector or advisor	0		10		10		10		10		10		0		0		10	
108	The school promotes and organizes safety contests	0		0		0		0		0		0		0		0		10	
109	Emergency procedures have been established for emptying the facilities	10		10		10		10		10		10		10		10		10	
110	All safety procedures are posted conspicuously near all areas of operatio	10		10		10		0		0		10		0		10		10	
111	The school has access to qualified individuals to administer first aid	0		10		10		10		10		10		10		10		0	
112	Instructors are First Aid certified	0		10		0		0		0		10		10		10		0	
113	The school has a policy and/or procedure for the administration of first aid	0		10		10		0			1	10		10		10		10	
		40	0	70	1	80	0	50	0	50	1	70	0	50	0	60	0	70	0
	GENERAL SAFETY PRACTICES																		
114	Routine preventative maintenance is practiced	10		0		10		10		10		10		10		0		10	
115	All maintenance problems and requests for improvement are recorded	0		10		0		10		10		10		0		0		10	
116	Facilities are inspected regularly for hazards and needed corrections	0		10		10		10		10		10	1	10		0		10	
117	An inspection checklist is used when making the above inspections		1	10		10		10		10		10	1	10		0		10	
118	All defective equipment and hazards are reported immediately	10		10		0		10		10		10		10		0		10	
119	Records of all inspections are readily available for reference		1	10		10		10		10		10		10		0		10	
120	Safety inspections of the shop are also made by a student safety committ	0		0		0		0		0		0		0		0		10	
121	Students are rotated on the student safety committee		1	0		0		0		0		0			1	0		0	
122	Lockers are inspected regularly for cleanliness and fire hazards		1	0		10			1		1		1	10			1	0	
123	Locker doors are kept closed		1	10		10			1		1		1	10			1	10	
124	One instructor has the overall responsibility for each major facility	10		10		10		10		10		10		10		0		10	
125	Instructor supervision is provided at all times during laboratory sessions	10		10		10		10		10		10		10		0		10	
126	All main power switches are " off " when laboratories are not in session	0		0		0		0		10		10		0		0		10	
127	All machines are shut off when the instructor is out of the laboratory	10		0		10		10		10		10		10		10		10	
128	All machines are shut off while unattended	10		10		10		10		10		10		10		10		10	
129	All machines are off and tagged when being cleaned or adjusted	0		0		10		10		10		10		10		10		10	
130	Continuous proper examples are practiced by the instructor	10		10		10		10		10		10		10		10		10	
131	All accidents are reported for immediate attention and analysis	10		10		10		10		10		10		10		10		10	
132	All accident analyses are used to implement prompt corrective measures	10		10		10		10		10		10		10		0		10	
133	Activities are selected based on students' ability & maturation level	10		10		10		10		10		10		10		10		10	
134	Machine operation instructions are posted or available near areas of oper	10		0		0		0		0			1	0		10		0	
135	Tools are kept sharp, clean, and in safe working order	10		10		10		10		10		10		10		0		10	
136	Materials being worked are secured when the operation so demands	10		10		10		10		10		10		10		10		10	
137	All work undertaken is approved through an established method	10		10		10		10		0		10		10		0		10	
138	Proper warnings are given in using toxics, caustics and volatile materials	10		10		10		10		10		10		10		0		10	
139	The school promotes and develops the sense of safety consciousness	10		10		10		10		10		10		0		0		10	
140	Questions on safety are included in the instructional program	10		10		10		10		10		10		10		10		10	

First column of each school = Field Safety Rating
Second column of each school = Non Applicables

FIELD DATA

Nº	Items	School #																	
		1		2		3		4		5		6		7		8		9	
141	Printed safety rules are given to each student	10		10		10		10		10		10		10		10		10	
142	Motion and/or slide films on safety are used in the instruction	10		10		10		10		10		10		0		10		10	
143	Occasional talks on safety are given by industry or outside specialists	0		0		0		10		10		0		10		10		10	
144	Students that constantly violate safety regulations are removed from class	0		10		10		10		10		10		10		10		10	
145	Dangerous horseplay and practical jokes are prohibited	10		10		10		10		0		10		10		10		10	
146	A proper record is kept of safety instruction given	10		0		10		10		10		10		10		10		10	
147	Inappropriate garments or other materials are kept out of activity areas	10		10		10		10		10		10		10		10		10	
148	Safety bulletin boards and posters are part of the total safety program	10		0		10		0		10		10		0		0		0	
149	Only spark lighters are used to light torches	10		10		10		10		10			1	10		10			10
150	Safety cans are provided for storing flammable liquids	0		10		10		10		10		10		0		0		0	
151	Students are tested for safety knowledge	10		10		10		10		10		10		10		10		10	
152	Students are tested for safety ability	10		10		10		10		10		10		10		0		10	
153	Students are instructed in methods for handling and lifting materials	10		0		0		0		0		10		10		10		10	
154	Students are instructed to clear off machines before turning them on	10		10		10			1	10			1	10		10		10	
155	Students are instructed never to leave a machine while it is in operation	10		10		10		10		10		10		10		10		10	
156	Students are instructed never to stop moving parts of a machine by hand	10		10		10		10		10		10		10		10		10	
157	Students are instructed to stay clear of other operating machines	10		10		10		10		10		10		10		10		10	
158	Students are instructed not to annoy or alarm an operator	10		10		10		10		10		10		10		10		10	
159	Students are instructed in the use of the tools and equipment they operate	10		10		10		10		10		10		10		10		10	
160	Students are tested and authorized before operating machines	10		10		10		10		10		10		10		10		10	
161	Students are alerted and monitored for possible hazardous operations	10		10		10		10		10		10		10		10		10	
162	Students are instructed as to how to report hazards and fires	10		10		10		10		10		10		10		10		10	
163	Students sleeves are rolled above elbows when operating machines	10		10			1	10		10			1	10		10		10	
164	Students avoid the use of loose clothing, jewelry, ties, long hair, etc.	10		10		10		10		10		10		0		10		10	
165	The students are not exposed to unreasonable environmental changes	10		10		10		10		0		10		10		10		10	
166	Noise from laboratory or other sources do not annoy or distract students	0		10		10		10		0		10		10		0		0	
167	Scrap stock is promptly put in scrap boxes	10		10			1	10		10			1	0		0		10	
168	Containers for oily rags are frequently emptied	10		10		10		10		0			1		1	0		10	
169	Waste (shavings, sawdust, paint, etc.) is disposed of daily	0		10			1	10		0			1	10		0		10	
170	Machines are kept in safe operating condition at all times	10		0		10		10		10		10		10		0		10	
171	Temperature control for all seasons is adequate	0		10		10		10		0		10		0		10		10	
172	Noise is always kept within acceptable levels at all laboratory locations	0		10		10		10		10		10		10		10		10	
173	Proper tools and materials are always available for machine cleaning	0		10		10		0		10		0		0		0		0	
174	All guards are used at all times	10		10		10		10		10		10		0		0		0	
175	Signs are always secured to machines that are out of order	10		0		0		10		0		0		0		0		0	
176	Power panel switches are always "off" when machines are out of order	0		10		10		0		10			1	10		0		10	
177	Compressed air is always reduced to 30 psi when used for cleaning	10		0			1		1	0			1		1	0		10	
178	Compressed air is always provided with proper tip when used for cleanin	10		10			1		1		1		1		1	0		10	
179	Extension cords are always avoided as permanent installations	10		0		10			1	10		10		10		10		10	

First column of each school = Field Safety Rating
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FIELD DATA 6

N°	Items	School #																	
		1		2		3		4		5		6		7		8		9	
180	Arc welding is always done only in dry areas	10		10		10		10		10			1	10		10		10	
181	Welding is always done only in areas free of combustible materials	10		10		10		10		10			1	10		0		10	
182	Fire proof bulk storage is provided outside the facilities	0		10			1	0		10			1	0		0		0	
183	All waste and oily rags are always placed in the correct containers	0		10			1	10			1		1	10		0		0	
184	Noise levels never affect speech intelligibility or present a health hazard	0		10		10		0		0		10		0		0		10	
185	There are not unusual human factors incompatibilities for working student	10		10		10		0		0		10		10			1	10	
186	Reflective screens are always used as protection from arc flashes and bu	10		10		10		10		10			1	0		0		10	
187	The laboratory keeps an inventory of all chemicals used	0		0			1	10			1	10			1	0		0	
188	The laboratory uses materials safety handling sheets	0		0			1		1		1		1	0		0		0	
189	The instructors are certified in handling chemicals	0		10			1	10			1	10		10		0		0	
190	The instructor (s) has (have) 40 hour hazardous waste training	0		0		0		10			1	0		0		0		0	
191	The laboratory is inspected for safety on a monthly basis	0		10		10		10		0		0		0		0		0	
192	The laboratory has procedures for dealing with chemical spills	0		10			1	10		0		0		0		0		0	
193	The laboratory has a planned response for chemical spills	0		10			1	0		0		0		0		0		0	
		510	5	610	0	580	12	610	7	540	8	530	20	530	5	350	3	610	21
	PERSONAL PROTECTIVE EQUIPMENT																		
194	Personal protective equipment is washed and disinfected as needed	10		10		10			1	10			1	10			1	0	
195	Provisions are made for cleaning and disinfecting of respirators		1	0			1	10			1		1		1		1	0	
196	Eye-wash baths and showers are available when using caustic materials	0		10			1	10		0			1		1		1	0	
197	Eye-protective devices are disinfected & returned to proper racks after use		1	10			1	10			1		1	0			1	0	
198	Observers use acceptable protection	10		10		10		10		10			1	10		0		0	
199	Protective clothing (aprons, shoes, gloves, etc.) are used when required	10		10		10		10		10		10		10		0		10	
200	Respiration and noise suppression devices are used as required	0		0		0		10		0			1	0			1	0	
201	Eye protection devices are worn when required	10		10		10		10		10		10		10		10		10	
202	Shields are provided for electric welding	10		10		10		10		10			1	10		10		10	
203	Goggles with the proper lenses are used when torch welding	10		10		10		10		10			1	10		10		10	
204	An arc-welding helmet with correct lenses is used when electric welding	10		10		10		10		10			1	10		10		10	
		70	2	90	0	70	3	100	1	70	2	20	9	70	2	40	5	50	
	FIRE PROTECTION																		
205	Instructors are knowledgeable in the use of the fire extinguishers	10		10		10		10		10		10		10		10		10	
206	Instructors know the procedures in the event of fire	10		10		10		10		10		10		10		10		10	
207	Filters in spray booths are replaced regularly		1	0			1		1		1		1		1		1	10	
208	Students know the location and use of the various fire extinguishers	10		10		10		10		10		10		10		0		10	
209	Students are instructed on the basics of fire prevention	10		10		10		10		10		10		10		10		10	
210	Students are instructed as to how to report fires	10		10		10		10		10		10		10		10		10	
	TOTALS	50	1	50	0	50	1	50	1	50	1	50	1	50	1	40	1	60	0

(Appendix C con'd)

	Items	School #																	
		10		11		12		13		14		15		16		17			
1	General appearance is conducive to student safety	5		5		9		10		10		10		4		10			
2	Floors are kept in a condition conducive to student safety	7		8		10		10		7		10		10		10			
3	Walls and ceilings are kept in a condition conducive to student safety	9		8		10		10		8		10		10		8			
4	The facilities are free from evident architectural barriers	7		10		8		10		10		10		10		10			
5	There are sufficient exits in each laboratory	10		6		10		10		10		10		10		10			
6	Storage space for tools and materials is adequate	7		8		10		10		10		10		10		10			
7	Storage space for equipment and materials being worked on is adequate	7		2		6		8		10		10		10		6			
8	Stairways have safe treads and risers		1		1		1		1		1	10			1		1		
9	Stairways have approved railings		1		1		1		1		1	10			1		1		
10	Mezzanines are protected with toe boards or railings		1		1		1		1		1	10		0			1		
11	The facilities are wheelchair accessible (including laboratories)	5		10		10		10		0		0		10		10			
	TOTALS	57	3	57	3	73	3	78	3	65	3	100	0	74	2	74	3		
	ENVIRONMENT																		
12	Facilities are pleasant & conducive to student safety	8		6		10		10		10		10		6		8			
13	Facilities are clean and orderly	5		6		9		10		2		6		6		10			
14	The area or square feet of laboratory per student is adequate	5		0		2		0		0		0		0		0			
15	Illumination is sufficient and non glare lighting is provided for all work area	7		9		10		10		5		10		10		10			
16	Ventilation is adequate and proper for conditions	8		9		6		10		2		0		4		6			
17	Air is free from dust, smoke, or other contaminants	5		6		5		10		2		2		0		6			
	TOTALS	38	0	36	0	42	0	50	0	21	0	28	0	26	0	40	0		
	MACHINES AND EQUIPMENT																		
18	General arrangement conforms to good safety practices	5		7		10		8		10		4		8		10			
19	All stationary machines are securely fastened in place	0		6		10			1	0		8		0		0			
20	Machines are located for required process compatibility	10		6		9		10		8		4		10		10			
21	Auxiliary equipment is orderly and readily available	7		8		10		8		10		8		10		10			
22	Work stations are designed to prevent hazards from excess heat or noise	10		10		5		7		10		6			1	10			
23	Work stations are designed to prevent hazards from fire or fumes		1	10		10		10		3		8			1	10			
24	Work stations are designed to prevent hazards from other machines	0		8		9		10		10		8		10		10			
25	Parts of machines needing special caution are color coded	0		5		10		5		10		0		0		0			
26	All machines guards are in proper position for safe machine operation	10		8		7		7		10		0		6		8			
27	Squaring shears are equipped with finger guards		1		1		1		1		1		1		1		1		
28	Squaring shears are equipped with foot treadle stops		1		1		1		1		1		1		1		1		
29	Jointer knives are equipped with left and right guards		1		1		1		1	10			1		1		1		
30	Abrasive wheels are equipped with safety eye shields		1	10		10		10		0		0		10		0			
31	Abrasive wheels are equipped with tool rests		1	10		10		10		0		0		0		10			
32	Abrasive wheels are equipped with guards		1	10		8		10		0		0		10		10			
33	Table saws are equipped with guards and anti-kickback system		1	8		4			1	10		0		10		0			
34	Radial saws are guarded and equipped with anti-kickback device		1	10		10			1	10			1	10		6			

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	Items	School #															
		10		11		12		13		14		15		16		17	
35	Radial saws are equipped with forward stop and positive saw return		1	10		10			1	10			1	10		0	
36	Machine belts and pulleys are equipped with guards		1	5		10		10		10		10			1	10	
37	Piped welding systems have back pressure valves in both lines		1		1		1		1		1		1		1		1
38	Piped welding systems have no quick opening shut off valves		1		1		1		1		1		1		1		1
39	Torches and regulators are in good operating condition	10		8		10		10		10		10		10		10	
40	Hoses are maintained in good condition	8		10		10		10		10		10		10		10	
41	Anti (fire) flashbacks are installed where required in all hoses and lines		1	10		0		10		10			1	0		10	
42	Welding arcs cannot strike cylinders, gas or water lines	8		10		10		10		10		10		10		0	
43	Electrode holders are maintained and stored in good condition	10		10		10		8		10		8		0		10	
44	Proper ventilation is provided in welding areas	5		2		7		10		0		4		0		6	
45	All hand-held power tools are equipped with a "dead man" switch		1	5		0		10		0		0		10		0	
46	All electrical apparatus in areas of concentrated vapors are vapor proof		1		1		1		1		1		1		1		1
47	All hoisting devices are in safe operating condition		1		1		1		1	10			1		1		1
		93	17	197	7	201	7	186	11	195	5	113	10	150	10	167	15
	SAFETY CONDITIONS																
48	Nonskid surfaces are provided around machines	0		2		10		0		0		0		0		0	
49	All welding is done in screened areas	10		10		10		0		7		0		10		0	
50	Cylinders are secured upright and stored in ventilated and clear areas	0		8		10		10		10		10		10		0	
51	Danger zones are properly identified and guarded	0		6		9		0		10		0		0		10	
52	Aisles are clear of protruding objects	10		5		10		10		5		8		8		10	
53	Stairways have unobstructed access		1		1		1		1		1	10			1		1
54	Railings are color coded		1		1		1		1		1	0			1		1
55	Stairways are color coded		1		1		1		1		1	0			1		1
56	Electrical outlets and circuits are properly identified	0		10		8		10		0		6		10		10	
57	Exits are adequately and properly identified	0		8		10		10		0		10		10		10	
58	Walls are clear of hanging objects that might fall	5		9		10		10		10		6		10		10	
59	Utility lines are properly located and identified	5			1	9		10		10		10			1	10	
60	A master power switch panel controls all electrical outlets	0		10		10		10		10		10		10		10	
61	Individual machine power switches are installed in power panels	10		10		10		10		10		10		10		10	
62	Extension cords are in good condition (not spliced)	10		10		10		8		10		8		10		10	
63	Extension cords have three-way grounded plugs	10		10		10		10		10		8		10		8	
64	Cables are routed so that they are accessible for inspection and repair	10			1	10		10		10		10		10		10	
65	All switches are enclosed	10		10		10		10		10		10		10		10	
66	No temporary wiring is evident	10		10		10		10		10		10		10		10	
67	The laboratory has eye wash bottles	0		1		10		10		0		0		0		10	
68	The laboratory has chemical spill kits	0		0		0			1	0		0		0		0	
69	The laboratory has safety showers	0		0		0			1	0		0		0		0	
70	An adequately stocked first aid cabinet is provided	5		0		10		9		10		0		10		10	
		188	23	321	14	377	12	343	18	337	9	239	12	298	16	315	20

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N°	Items	School #															
		10		11		12		13		14		15		16		17	
71	Good housekeeping practices are evident	8		5		10		9		3		8		6		10	
72	Benches are kept orderly	8		5		10		9		5		8		4		10	
73	Corners and dead spots are clean and clear	8		5		9		9		0		8		6		10	
74	Special tool racks are in orderly condition at bench and machine sites	8		8		9			1	2		8			1	10	
75	Tools, supplies, and/or materials are orderly	8		5		10		6		2		8		8		10	
76	Sufficient scrap boxes are provided	10		8		8		10		10		10		10		10	
77	Materials are stored in an orderly and safe condition	8		8		10		8		4		8		6		10	
		58	0	44	0	66	0	51	1	26	0	58	0	40	1	70	0
	FIRE PROTECTION																
78	Sufficient fire extinguishers are available	10		10		10		10		10		10		10		10	
79	Fire extinguishers are of the proper type	10		10		10		10		10		10		10		10	
80	Fire extinguishers are adequately located, maintained and supplied	10		10		10		10		10		10		10		10	
81	The laboratory has fire detectors	0		10		10		10		0		0		0		0	
82	Spray room doors swing out and cannot be locked from the inside		1	10			1		1		1		1		1		1
83	Storage and waste containers are fire-proof	0		5		10		0		0		0		0		0	
84	Wash tanks for parts that use solvents are fire proof		1		1	10			1	0		0			1		1
85	Fire proof storage cabinets are provided for all flammable liquids	0		10		9		0		0		0		0			1
		30	2	65	1	69	1	40	2	30	1	30	1	30	2	30	3
	ERGONOMICS AND SAFETY ENGINEERING																
86	Room furniture and equipment are arranged to avoid accidents	0		8		9		10		7		8		10		10	
87	Aisles are properly located for efficient performance	0		5		8		9		10		10		10		10	
88	The tasks required from students are human factors compatible	10		6		10		10		10		10		10		10	
89	Dials, controls and displays conform to human factors standards	10		6		10		10		10		10		10		10	
90	There is local or direct lighting for equipment where needed	10		8		10		10		5		10			1	10	
91	The work areas are free from direct or reflected glare sources	10		9		10		10		10		10		10		10	
92	The work areas are free from evident sharp edges or trip hazards	8		6		10		10		4		8		10		10	
93	The work areas are free from evident slip and fall hazards	8		7		10		10		3		6		8		10	
94	Tool racks are available where needed	0		5		9		10		10		8			1	0	
95	Areas for teaching and demonstration are available	10		10		9		10		10		10		10		10	
96	Work stations are designed to prevent hazards from passing students	10		5		9		7		10		6		10		10	
97	Work stations are designed to protect observing students from hazards	10		10		10		10		10		8		10		10	
98	Safety instructions for use of each machine are posted or readily available	0		5		10		0		0		6		0		10	
99	All machine switches are within easy reach of the operators	10		8		10		10		10		10		10		10	
100	A visible "off" position is located on each machine	10		8		10		10		10		10		10		10	
101	Machines are located in such way that operator space is adequate	5		10		9		8		8		8		10		10	
102	Machines are located in such a way that required supervision is possible	10		8		10		10		8		8		10		10	
103	Master and other power panels are easily accessible	0		10		10		10		0		10		10		10	
		121	0	134	0	173	0	164	0	135	0	156	0	148	2	170	0

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(Appendix C con'd)

N°	Items	School #															
		10		11		12		13		14		15		16		17	
	SCHOOL SAFETY POLICIES AND PROCEDURES																
104	A safety policy or rules are enforced for safe shop operation	10		10		10		10		10		10		10		10	
105	Number of laboratory groups are kept appropriate for the respective work	10		10		10		10		0		0		10		0	
106	Laboratory areas are provided with custodial services	0		0		10		0		0		10		10		0	
107	The school uses the services of a safety inspector or advisor	0		10			1	10		10		0		0		0	
108	The school promotes and organizes safety contests	0		0			1	10		10		0		0		0	
109	Emergency procedures have been established for emptying the facilities	10		10		10		10		10		10		10		10	
110	All safety procedures are posted conspicuously near all areas of operatio	0		0			1	0		10		0		0		0	
111	The school has access to qualified individuals to administer first aid	10		10		10		0		10		10		10		10	
112	Instructors are First Aid certified	0		0		10		0		0		0		0		0	
113	The school has a policy and/or procedure for the administration of first aid	10		10		10		10		10		10		10		10	
		50	0	60	0	70	3	60	0	70	0	50	0	60	0	40	0
	GENERAL SAFETY PRACTICES																
114	Routine preventative maintenance is practiced	10		10		10		10		10		10		10		10	
115	All maintenance problems and requests for improvement are recorded	0		10		0		10		10		0		10		0	
116	Facilities are inspected regularly for hazards and needed corrections	10		10		0		0		10		10		10		10	
117	An inspection checklist is used when making the above inspections	0		0		0		0		10		10		0		0	
118	All defective equipment and hazards are reported immediately	10		10		0		0		10		10		10		10	
119	Records of all inspections are readily available for reference		1	10			1	0		0		0		0		0	
120	Safety inspections of the shop are also made by a student safety committ	0		10			1	0		10		0		0		0	
121	Students are rotated on the student safety committee		1	0			1	0		10		0		0		0	
122	Lockers are inspected regularly for cleanliness and fire hazards	10			1		1	10		10		0		0			1
123	Locker doors are kept closed	10			1		1	0		10		0		10			1
124	One instructor has the overall responsibility for each major facility	10		0		0		10		10		10		10		10	
125	Instructor supervision is provided at all times during laboratory sessions	10		10		10		10		10		10		10		10	
126	All main power switches are " off " when laboratories are not in session		1	0		10		10		10		10		10		0	
127	All machines are shut off when the instructor is out of the laboratory	10		10		10		10		10		10		10		10	
128	All machines are shut off while unattended	10		10		10		10		10		10		10		10	
129	All machines are off and tagged when being cleaned or adjusted	0		0		10		10		10		0		10		10	
130	Continuous proper examples are practiced by the instructor	10		10		10		10		10		10		10		10	
131	All accidents are reported for immediate attention and analysis	10		10		10		10		10		10		10		10	
132	All accident analyses are used to implement prompt corrective measures																
133	Activities are selected based on students' ability & maturation level																
134	Machine operation instructions are posted or available near areas of operation																
135	Tools are kept sharp, clean, and in safe working order																
136	Materials being worked are secured when the operation so demands	10		10		10		10		10		10		10		10	
137	All work undertaken is approved through an established method	10		10		10		10		10		10		10		10	
138	Proper warnings are given in using toxics, caustics and volatile materials	10		10		10		0		10		10		0		10	
139	The school promotes and develops the sense of safety consciousness	10		10		10		10		10		10		10		10	
140	Questions on safety are included in the instructional program	10		10		10		10		10		10		10		10	

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Nº	Items	School #															
		10		11		12		13		14		15		16		17	
141	Printed safety rules are given to each student	10		10		10		10		10		10		10		0	
142	Motion and/or slide films on safety are used in the instruction	10		10		10		10		10		10		10		10	
143	Occasional talks on safety are given by industry or outside specialists	0		10		10		10		10		10		10		10	
144	Students that constantly violate safety regulations are removed from class	10		10		10		10		10		10		10		0	
145	Dangerous horseplay and practical jokes are prohibited	10		10		10		10		10		0		10		10	
146	A proper record is kept of safety instruction given	10		0		10		10		10		0		10		10	
147	Inappropriate garments or other materials are kept out of activity areas	10		10		10		10		10		10		10		10	
148	Safety bulletin boards and posters are part of the total safety program	0		0		10		0		10		10		0		10	
149	Only spark lighters are used to light torches	10		10		10		10		10		10		10		10	
150	Safety cans are provided for storing flammable liquids		1	0			1	0		10		0		0		0	
151	Students are tested for safety knowledge	10		10		10		10		10		10		10		10	
152	Students are tested for safety ability	10		10		10		0		10		10		10		10	
153	Students are instructed in methods for handling and lifting materials	10		10		10		0		10		10		10		10	
154	Students are instructed to clear off machines before turning them on	10		10		10		0		10		10		10		10	
155	Students are instructed never to leave a machine while it is in operation	10		10		10		10		10		10		10		10	
156	Students are instructed never to stop moving parts of a machine by hand	10		10		10		10		10		10		10		10	
157	Students are instructed to stay clear of other operating machines	10		10		10		10		10		10		10		10	
158	Students are instructed not to annoy or alarm an operator	10		10		10		10		10		10		10		10	
159	Students are instructed in the use of the tools and equipment they operate	10		10		10		10		10		10		10		10	
160	Students are tested and authorized before operating machines	10		10		10		10		10		10		10		10	
161	Students are alerted and monitored for possible hazardous operations	10		10		10		10		10		10		10		10	
162	Students are instructed as to how to report hazards and fires	10		10		10		10		10		10		10		10	
163	Students sleeves are rolled above elbows when operating machines	10		10		10		0		10		0		10		0	
164	Students avoid the use of loose clothing, jewelry, ties, long hair, etc.	10		0		10		10		10		10		10		10	
165	The students are not exposed to unreasonable environmental changes	10		10		10		10		10		10		10		0	
166	Noise from laboratory or other sources do not annoy or distract students	10		0			1	0		0		0		10		0	
167	Scrap stock is promptly put in scrap boxes	10		0		10		10		10		10		0		10	
168	Containers for oily rags are frequently emptied		1	10		10		10		10		10		0			1
169	Waste (shavings, sawdust, paint, etc.) is disposed of daily	10		10		0		10		10		0		10		10	
170	Machines are kept in safe operating condition at all times	10		0		10		10		10		10		10		10	
171	Temperature control for all seasons is adequate	0		10		10		10		10		10		0		0	
172	Noise is always kept within acceptable levels at all laboratory locations	10		0		0		10		10		0		0		10	
173	Proper tools and materials are always available for machine cleaning	0		0		10		0		10		0		10		10	
174	All guards are used at all times	10		0		10		0		10		0		10		0	
175	Signs are always secured to machines that are out of order	0		10		10		0		10		0		10		0	
176	Power panel switches are always "off" when machines are out of order	10		10		10		10		10		10		0		10	
177	Compressed air is always reduced to 30 psi when used for cleaning		1	10			1		1	10		10		0			1
178	Compressed air is always provided with proper tip when used for cleaning		1	10			1		1	10		0		10			1
179	Extension cords are always avoided as permanent installations	10		10		10		10		10		10		10		10	

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N°	Items	School #															
		10		11		12		13		14		15		16		17	
180	Arc welding is always done only in dry areas	10		10		10		10		10		10		10		10	
181	Welding is always done only in areas free of combustible materials	10		10		10		10		10		10		10		10	
182	Fire proof bulk storage is provided outside the facilities	0		10		10		0		10		0		0		0	
183	All waste and oily rags are always placed in the correct containers		1	0		10		0		10		0		0		0	
184	Noise levels never affect speech intelligibility or present a health hazard	10		10		10		0		0		0		0		0	
185	There are not unusual human factors incompatibilities for working student	10		10			1	10		0		10			1	0	
186	Reflective screens are always used as protection from arc flashes and bu	10		0		0		0		10		0		10		0	
187	The laboratory keeps an inventory of all chemicals used	0		0		10		0		10		0		10			1
188	The laboratory uses materials safety handling sheets	0		0		10		0		10		0		10			1
189	The instructors are certified in handling chemicals	0		0		10		0		10		0		10			1
190	The instructor (s) has (have) 40 hour hazardous waste training	0		0		10		0		10		0		10		0	
191	The laboratory is inspected for safety on a monthly basis	0		0		10		10		0		0		10		0	
192	The laboratory has procedures for dealing with chemical spills		1	0		10		0		0		0		10			1
193	The laboratory has a planned response for chemical spills		1	0		10		0		10		0		10			1
		510	10	500	2	580	10	460	2	700	0	470	0	580	1	440	33
	PERSONAL PROTECTIVE EQUIPMENT																
194	Personal protective equipment is washed and disinfected as needed	10		10		10		0		10		10			1		1
195	Provisions are made for cleaning and disinfecting of respirators		1	0		0			1	10		10			1		1
196	Eye-wash baths and showers are available when using caustic materials		1	0		10		10		0		0		0			1
197	Eye-protective devices are disinfected & returned to proper racks after us	0		0		10		10			1	10		0			1
198	Observers use acceptable protection	10		10		10		10		10		10		0			1
199	Protective clothing (aprons, shoes, gloves, etc.) are used when required	10		10		10		10		10		10		10			1
200	Respiration and noise suppression devices are used as required		1	10			1		1	10		0		0			1
201	Eye protection devices are worn when required	10		10		10		10		10		10		10		10	
202	Shields are provided for electric welding	10		10		10		10		10		10		10		10	
203	Goggles with the proper lenses are used when torch welding	10		10			1	10		10		10		10		10	
204	An arc-welding helmet with correct lenses is used when electric welding	10		10		10		10		10		10		10		10	
		70	3	80	0	80	2	80	2	90	1	90	0	50	2	40	7
	FIRE PROTECTION																
205	Instructors are knowledgeable in the use of the fire extinguishers	10		10		10		10		10		10		10		10	
206	Instructors know the procedures in the event of fire	10		10		10		10		10		10		10		10	
207	Filters in spray booths are replaced regularly		1		1	0			1	10			1		1		1
208	Students know the location and use of the various fire extinguishers	10		10		10		10		10		10		10		10	
209	Students are instructed on the basics of fire prevention	10		10		10		10		10		10		10		10	
210	Students are instructed as to how to report fires	10		10		10		10		10		10		10		10	
		50	1	50	1	50	0	50	1	60	0	50	1	50	1	50	1

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	Items	School #															
		18		19		20		21		22		23		24		25	
1	General appearance is conducive to student safety	7		4		7		7		10		8		8		9	
2	Floors are kept in a condition conducive to student safety	8		9		8		7		9		9		10		10	
3	Walls and ceilings are kept in a condition conducive to student safety	8		10		8		8		10		9		6		10	
4	The facilities are free from evident architectural barriers	10		10		8		10		10		9		10		8	
5	There are sufficient exits in each laboratory	10		10		10		10		10		10		10		10	
6	Storage space for tools and materials is adequate	9		6		8		10		10		7		0		9	
7	Storage space for equipment and materials being worked on is adequate	9		2		8		8		9		8		0		9	
8	Stairways have safe treads and risers		1		1		1		1		1	1			1		1
9	Stairways have approved railings		1		1		1		1		1	4			1		1
10	Mezzanines are protected with toe boards or railings		1		1		1		1		1	5		10			1
11	The facilities are wheelchair accessible (including laboratories)		1	7		8		0		10		0				10	
	TOTALS	61	4	58	3	65	3	60	3	78	3	70	0	54	2	75	3
	ENVIRONMENT																
12	Facilities are pleasant & conducive to student safety	8		7		8		9		10		9		8		9	
13	Facilities are clean and orderly	8		7		9		7		9		9		8		9	
14	The area or square feet of laboratory per student is adequate	8		0		6		8		10		7		8		7	
15	Illumination is sufficient and non glare lighting is provided for all work area	9		7		10		9		10		7		8		8	
16	Ventilation is adequate and proper for conditions	10		10		10		10		9		6		4		10	
17	Air is free from dust, smoke, or other contaminants	10		10		8		9		9		5		0		9	
	TOTALS	53	0	41	0	51	0	52	0	57	0	43	0	36	0	52	0
	MACHINES AND EQUIPMENT																
18	General arrangement conforms to good safety practices	9		7		7		10		9		8		8		8	
19	All stationary machines are securely fastened in place	0		0		10		9		10		0		6			1
20	Machines are located for required process compatibility	9		5		10		10		10		5		6		9	
21	Auxiliary equipment is orderly and readily available	6		6		8		9		10			1	0		9	
22	Work stations are designed to prevent hazards from excess heat or noise	10		10		10		10		9		8		5		10	
23	Work stations are designed to prevent hazards from fire or fumes	10		6		7		10		10		8		8		10	
24	Work stations are designed to prevent hazards from other machines	10		6		9		10		10		8		8		9	
25	Parts of machines needing special caution are color coded	0		7		0		8		6		0		0		0	
26	All machines guards are in proper position for safe machine operation	9		10		10		9		9		2		10		9	
27	Squaring shears are equipped with finger guards		1		1		1		1		1		1		1		1
28	Squaring shears are equipped with foot treadle stops		1		1		1		1		1		1		1		1
29	Jointer knives are equipped with left and right guards		1		1		1		1		1		1	10		10	
30	Abrasive wheels are equipped with safety eye shields		1	10		0		10		0		2		5		10	
31	Abrasive wheels are equipped with tool rests		1	10		10		10		10		4		5		10	
32	Abrasive wheels are equipped with guards		1	10		10		10		10		9		10		10	
33	Table saws are equipped with guards and anti-kickback system	10		10			1		1		1		1	0		10	
34	Radial saws are guarded and equipped with anti-kickback device	10			1		1		1		1		1	0		10	

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		18		19		20		21		22		23		24		25	
35	Radial saws are equipped with forward stop and positive saw return	10			1		1		1		1		1	5		0	
36	Machine belts and pulleys are equipped with guards	9		10		9		10			1		1	10		10	
37	Piped welding systems have back pressure valves in both lines		1		1		1		1		1	10			1		1
38	Piped welding systems have no quick opening shut off valves		1		1		1		1		1	0			1		1
39	Torches and regulators are in good operating condition	9		10			1	10		10		9		10		10	
40	Hoses are maintained in good condition	9		10		10		10		10		9		10		10	
41	Anti (fire) flashbacks are installed where required in all hoses and lines	8		0		0		10		10		10		0		10	
42	Welding arcs cannot strike cylinders, gas or water lines	10		10		10		10		10		9		0		10	
43	Electrode holders are maintained and stored in good condition	10		10		9		10		9		9		6		9	
44	Proper ventilation is provided in welding areas	10		10		9		10		9		0		4		10	
45	All hand-held power tools are equipped with a "dead man" switch	0		10		10		10		9		5		8		10	
46	All electrical apparatus in areas of concentrated vapors are vapor proof	0			1		1		1		1	10			1		1
47	All hoisting devices are in safe operating condition		1		1	10			1		1		1		1		1
		176	9	186	9	178	10	216	10	192	11	148	9	158	6	228	21
	SAFETY CONDITIONS																
48	Nonskid surfaces are provided around machines	0		0		0		7		10		0		0		0	
49	All welding is done in screened areas	0		0		0		7		10		0		8		10	
50	Cylinders are secured upright and stored in ventilated and clear areas	10		6		10		10		10		8		8		10	
51	Danger zones are properly identified and guarded	0		0		6		8		9		9		4		0	
52	Aisles are clear of protruding objects	10		10		9		7		9		8		4		9	
53	Stairways have unobstructed access		1		1		1		1		1	8			1		1
54	Railings are color coded		1		1		1		1		1	0			1		1
55	Stairways are color coded		1		1		1		1		1	0			1		1
56	Electrical outlets and circuits are properly identified	0		10		0		9		10		0		0		9	
57	Exits are adequately and properly identified	10		0		10		7		10		0		10		0	
58	Walls are clear of hanging objects that might fall	10		10		10		10		10		8		10		10	
59	Utility lines are properly located and identified	10		0		10		10		10		0		5		10	
60	A master power switch panel controls all electrical outlets	10		10		10		10		10		10		0		10	
61	Individual machine power switches are installed in power panels	10		10		10		10		10		10		10		10	
62	Extension cords are in good condition (not spliced)	10		0		10		10		10		10		10		10	
63	Extension cords have three-way grounded plugs	10		10		10		10		10		10		10		8	
64	Cables are routed so that they are accessible for inspection and repair	10		10		10		10		10			1	10		10	
65	All switches are enclosed	10		10		10		10		10		9		10		10	
66	No temporary wiring is evident	10		10		10		10		10		10		10		10	
67	The laboratory has eye wash bottles	0		0		0		0		0		0		0		0	
68	The laboratory has chemical spill kits	0		0		6		0		0		0		0		0	
69	The laboratory has safety showers	0		0		6		0		0		0		0		0	
70	An adequately stocked first aid cabinet is provided	0		10		0		0		10		0		0		0	
		296	13	302	14	335	14	371	15	389	16	263	11	275	11	364	26

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		18		19		20		21		22		23		24		25	
71	Good housekeeping practices are evident	9		7		8		10		9		8		8		9	
72	Benches are kept orderly	9		7		8		10		9			1	10		9	
73	Corners and dead spots are clean and clear	9		5		8		10		9		6		8		9	
74	Special tool racks are in orderly condition at bench and machine sites		1		1	7		10		10		5		10			1
75	Tools, supplies, and/or materials are orderly	9		6		7		10		9		6		8		9	
76	Sufficient scrap boxes are provided	8		10		8		10		8		8		4		8	
77	Materials are stored in an orderly and safe condition	9		6		8		10		9		8		8		10	
		53	1	41	1	54	0	70	0	63	0	41	1	56	0	54	1
	FIRE PROTECTION																
78	Sufficient fire extinguishers are available	0		10		10		10		9		9		10		10	
79	Fire extinguishers are of the proper type	0		10		10		10		10		10		10		10	
80	Fire extinguishers are adequately located, maintained and supplied	0		8		10		10		10		10		10		10	
81	The laboratory has fire detectors	0		0		10		0		10		10		10		10	
82	Spray room doors swing out and cannot be locked from the inside	10			1		1		1		1		1		1		1
83	Storage and waste containers are fire-proof	0		0		8		0			1	10		0		0	
84	Wash tanks for parts that use solvents are fire proof	0			1	7		0			1	8		0			1
85	Fire proof storage cabinets are provided for all flammable liquids	0		0		0		0		0			1	10		0	
		10	0	28	2	55	1	30	1	39	3	57	2	50	1	40	2
	ERGONOMICS AND SAFETY ENGINEERING																
86	Room furniture and equipment are arranged to avoid accidents	10		6		7		10		10		8		7		10	
87	Aisles are properly located for efficient performance	10		10		8		10		10		9		10		10	
88	The tasks required from students are human factors compatible	10		10		10		10		10		9		10		10	
89	Dials, controls and displays conform to human factors standards	10		10		8		10		10		8		5		10	
90	There is local or direct lighting for equipment where needed	10		10		9		10		10		7		8		10	
91	The work areas are free from direct or reflected glare sources	10		10		9		10		10		8		10		10	
92	The work areas are free from evident sharp edges or trip hazards	10		10		9		10		10		8		10		10	
93	The work areas are free from evident slip and fall hazards	10		7		9		10		10		7		9		9	
94	Tool racks are available where needed	0		0		8		10		9			1	5		0	
95	Areas for teaching and demonstration are available	10		5		8		10		10		8		10		9	
96	Work stations are designed to prevent hazards from passing students	10		7		8		10		10		9		6		10	
97	Work stations are designed to protect observing students from hazards	10		10		9		10		10		9		5		10	
98	Safety instructions for use of each machine are posted or readily available	10		0		7		8		9		0		8		0	
99	All machine switches are within easy reach of the operators	10		10		10		10		10		9		10		10	
100	A visible "off" position is located on each machine	10		10		10		10		10		9		10		10	
101	Machines are located in such way that operator space is adequate	10		8		8		10		10		9		10		0	
102	Machines are located in such a way that required supervision is possible	10		10		7		10		10		9		6		10	
103	Master and other power panels are easily accessible	10		10		10		10		9		9		8		9	
		170	0	143	0	154	0	178	0	177	0	135	1	147	0	147	0

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		18		19		20		21		22		23		24		25	
	SCHOOL SAFETY POLICIES AND PROCEDURES																
104	A safety policy or rules are enforced for safe shop operation	10		10		10		10		10		10		10		10	
105	Number of laboratory groups are kept appropriate for the respective work	0		10		0		10		10		10		10		10	
106	Laboratory areas are provided with custodial services	0		0		0		10		0		0		0		0	
107	The school uses the services of a safety inspector or advisor	0		0		10		0		0		0		10		10	
108	The school promotes and organizes safety contests	10		0		0		0		10		0		10		10	
109	Emergency procedures have been established for emptying the facilities	0		10		10		10		10		10		10		10	
110	All safety procedures are posted conspicuously near all areas of operatio	0		0		0		10		10		10		0		0	
111	The school has access to qualified individuals to administer first aid	0		0		10		10		10		10		0		10	
112	Instructors are First Aid certified	0		0		0		10		10		0		0		10	
113	The school has a policy and/or procedure for the administration of first aid	10		0		10		10		10		10		10		10	
		30	0	30	0	50	0	80	0	80	0	60	0	60	0	80	0
	GENERAL SAFETY PRACTICES																
114	Routine preventative maintenance is practiced	10		10		10		10		10		10		10		10	
115	All maintenance problems and requests for improvement are recorded	0		0		10		10		0		10		0		0	
116	Facilities are inspected regularly for hazards and needed corrections	10		10		0		10		10		10		10		10	
117	An inspection checklist is used when making the above inspections	10		0		0		0		10		0		10		10	
118	All defective equipment and hazards are reported immediately	10		10		10		10		10		0		10		10	
119	Records of all inspections are readily available for reference	0		0		0		10		0		0		10		0	
120	Safety inspections of the shop are also made by a student safety committ	0			1		1	0		10		0		0		10	
121	Students are rotated on the student safety committee	0			1		1	0			1	0			1	10	
122	Lockers are inspected regularly for cleanliness and fire hazards		1		1	10		0		10			1	10			1
123	Locker doors are kept closed		1		1	10		10		10			1	10			1
124	One instructor has the overall responsibility for each major facility	10		0		10		0		10		10		10		10	
125	Instructor supervision is provided at all times during laboratory sessions	10		10		10		10		10		10		10		10	
126	All main power switches are " off " when laboratories are not in session	10		10		10		0		0		10			1	0	
127	All machines are shut off when the instructor is out of the laboratory	10		10		10		10		0		10		10		10	
128	All machines are shut off while unattended	10		10		10		10		0		10		10		10	
129	All machines are off and tagged when being cleaned or adjusted	10		10		10		10		10		10		10		0	
130	Continuous proper examples are practiced by the instructor	10		10		10		10		10		10		10		10	
131	All accidents are reported for immediate attention and analysis	10		10		10		10		10		10		10		10	
132	All accident analyses are used to implement prompt corrective measures																
133	Activities are selected based on students' ability & maturation level																
134	Machine operation instructions are posted or available near areas of operation																
135	Tools are kept sharp, clean, and in safe working order																
136	Materials being worked are secured when the operation so demands	10		10		10		10		10		10		10		10	
137	All work undertaken is approved through an established method	10			1	10		10		10		10		10		10	
138	Proper warnings are given in using toxics, caustics and volatile materials		1	10		10		10		10		10		10		10	
139	The school promotes and develops the sense of safety consciousness	10		10		10		10		10		10		10		10	
140	Questions on safety are included in the instructional program	10		10		10		10		10		10		10		10	

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N°	Items	School #															
		18		19		20		21		22		23		24		25	
141	Printed safety rules are given to each student	10		0		10		10		10		10		10		10	
142	Motion and/or slide films on safety are used in the instruction	10		10		10		10		10		10		10		10	
143	Occasional talks on safety are given by industry or outside specialists	0		0		0		10		10			1	10		0	
144	Students that constantly violate safety regulations are removed from class	10		10		10		10		10		10		10		0	
145	Dangerous horseplay and practical jokes are prohibited	10		10		10		10		10		10		10		10	
146	A proper record is kept of safety instruction given	10		10		10		10		0		10		10		0	
147	Inappropriate garments or other materials are kept out of activity areas	10		10		10		10		0		10		10		0	
148	Safety bulletin boards and posters are part of the total safety program	10		0		10		10		10		0		10		0	
149	Only spark lighters are used to light torches	10		10		10		10		10		10		10		10	
150	Safety cans are provided for storing flammable liquids		1	0			1	10		0		10		10		10	
151	Students are tested for safety knowledge	10		10		10		10		10		10		10		10	
152	Students are tested for safety ability	10		10		10		10		10		10		10		10	
153	Students are instructed in methods for handling and lifting materials	10		10		10		10		10		10		10		10	
154	Students are instructed to clear off machines before turning them on	10		10		10		10		10		10		10		10	
155	Students are instructed never to leave a machine while it is in operation	10		10		10		10		10		10		10		10	
156	Students are instructed never to stop moving parts of a machine by hand	10		10		10		10		10		10		10		10	
157	Students are instructed to stay clear of other operating machines	10		10		10		10		10		10		10		10	
158	Students are instructed not to annoy or alarm an operator	10		10		10		10		10		10		10		10	
159	Students are instructed in the use of the tools and equipment they operate	10		10		10		10		10		10		10		10	
160	Students are tested and authorized before operating machines	10		10		10		10		10		0		10		10	
161	Students are alerted and monitored for possible hazardous operations	10		10		10		10		10		10		10		10	
162	Students are instructed as to how to report hazards and fires	10		0		10		10		10		10		10		10	
163	Students sleeves are rolled above elbows when operating machines	10		0		0		10		0		0		10		10	
164	Students avoid the use of loose clothing, jewelry, ties, long hair, etc.	10		10		10		10		10		10		10		10	
165	The students are not exposed to unreasonable environmental changes	10		10		10		10		10		10		10		10	
166	Noise from laboratory or other sources do not annoy or distract students	0		10		10		10		10		0		10		10	
167	Scrap stock is promptly put in scrap boxes	0		0		10		10		0		10		10		0	
168	Containers for oily rags are frequently emptied	10		0		10		10		10		10		10		0	
169	Waste (shavings, sawdust, paint, etc.) is disposed of daily	0		0		10		10		0		10		10		10	
170	Machines are kept in safe operating condition at all times	10		10		10		10		10		10		10		10	
171	Temperature control for all seasons is adequate	0		0		10		10		10		0		0		10	
172	Noise is always kept within acceptable levels at all laboratory locations	10		0		10		10		0		10		10		10	
173	Proper tools and materials are always available for machine cleaning	0		0		10		10		0		0		10		10	
174	All guards are used at all times	0		0		10		10		10		10		10		0	
175	Signs are always secured to machines that are out of order	0		0		0		10		10		0		10		0	
176	Power panel switches are always "off" when machines are out of order	10		10		10		10		10		10		10		0	
177	Compressed air is always reduced to 30 psi when used for cleaning		1	0		10		0		0			1		1		1
178	Compressed air is always provided with proper tip when used for cleaning		1	0		10		10		10			1		1		1
179	Extension cords are always avoided as permanent installations	10		10		10		10		10		10		10		0	

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Nº	Items	School #															
		18		19		20		21		22		23		24		25	
180	Arc welding is always done only in dry areas	10		10		10		10		10		10		10		10	
181	Welding is always done only in areas free of combustible materials	10		10		10		10		10		10		10		10	
182	Fire proof bulk storage is provided outside the facilities	0		0			1	0		10			1	10		0	
183	All waste and oily rags are always placed in the correct containers	10		0		10		10		10		10		10		10	
184	Noise levels never affect speech intelligibility or present a health hazard	0		10		10		0		0		10		10		10	
185	There are not unusual human factors incompatibilities for working student	10		10		10		10		10		10		10		10	
186	Reflective screens are always used as protection from arc flashes and bu	0		10		10		0		10		10		10		0	
187	The laboratory keeps an inventory of all chemicals used	0		0			1	10		0		0		10		0	
188	The laboratory uses materials safety handling sheets	10		0			1	0		10		0		0		0	
189	The instructors are certified in handling chemicals	10		0		0		0		10		0		0		0	
190	The instructor (s) has (have) 40 hour hazardous waste training	0		0		0		0		0		0		0		0	
191	The laboratory is inspected for safety on a monthly basis	0		0		0		0		0		0		0		0	
192	The laboratory has procedures for dealing with chemical spills	0		0		0		0		10		0		0		0	
193	The laboratory has a planned response for chemical spills	0		0		10		0		10		0		0		0	
		500	6	420	5	600	6	600	0	570	1	510	6	630	4	480	39
	PERSONAL PROTECTIVE EQUIPMENT																
194	Personal protective equipment is washed and disinfected as needed	10		0		10		10		10		0		10		10	
195	Provisions are made for cleaning and disinfecting of respirators		1	0		10		10			1	0			1	0	
196	Eye-wash baths and showers are available when using caustic materials		1	0			1	0			1	0		0			1
197	Eye-protective devices are disinfected & returned to proper racks after use		1	0			1	10			1	0			1	10	
198	Observers use acceptable protection		1	10		10		10		10		10		10		10	
199	Protective clothing (aprons, shoes, gloves, etc.) are used when required	10		10		10		10		10		10		10		10	
200	Respiration and noise suppression devices are used as required		1	10			1	0		0		10			1		1
201	Eye protection devices are worn when required	10		10		10		10		10		10		10		10	
202	Shields are provided for electric welding	10		10		10		10		10		10		10		10	
203	Goggles with the proper lenses are used when torch welding	10		10		10		10		10		10		10		10	
204	An arc-welding helmet with correct lenses is used when electric welding		1	10		10		10		10		10		10		10	
		50	6	70	0	80	3	90	0	70	3	70	0	70	3	80	2
	FIRE PROTECTION																
205	Instructors are knowledgeable in the use of the fire extinguishers	10		10		10		10		10		10		10		10	
206	Instructors know the procedures in the event of fire	10		10		10		10		10		10		10		10	
207	Filters in spray booths are replaced regularly	0			1		1	10			1		1		1		1
208	Students know the location and use of the various fire extinguishers	0		10		10		10		10		10		10		10	
209	Students are instructed on the basics of fire prevention	10		10		10		10		10		10		10		10	
210	Students are instructed as to how to report fires	10		10		1		10		10		10		10		10	
		40	0	50	1	41	1	60	0	50	1	50	1	50	1	50	1

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	Items	School #															
		26		27		28		29		30		31		32		33	
1	General appearance is conducive to student safety	5		5		5		10		6		7		8		7	
2	Floors are kept in a condition conducive to student safety	7		8		5		10		9		7		10		10	
3	Walls and ceilings are kept in a condition conducive to student safety	7		9		3		10		10		8		8		10	
4	The facilities are free from evident architectural barriers	5		9		3		10		10		7		10		10	
5	There are sufficient exits in each laboratory	8		8		10		10		10		7		2		10	
6	Storage space for tools and materials is adequate	8		0		2		10		6		7		6		10	
7	Storage space for equipment and materials being worked on is adequate	6		5		2		0		5		6		10		0	
8	Stairways have safe treads and risers		1	5			1		1		1		1		1		1
9	Stairways have approved railings		1	9			1		1		1		1		1		1
10	Mezzanines are protected with toe boards or railings		1		1		1		1		1		1		1		1
11	The facilities are wheelchair accessible (including laboratories)	6		5		7		10		0		0		5		10	
	TOTALS	52	3	63	1	37	3	70	3	56	3	49	3	59	3	67	3
	ENVIRONMENT																
12	Facilities are pleasant & conducive to student safety	5		3		5		10		10		8		10		9	
13	Facilities are clean and orderly	6		4		5		7		7		8		10		7	
14	The area or square feet of laboratory per student is adequate	3		3		0		0		0		3		8		0	
15	Illumination is sufficient and non glare lighting is provided for all work area	4		3		4		10		7		5		10		9	
16	Ventilation is adequate and proper for conditions	7		8		0		10		7		5		10		0	
17	Air is free from dust, smoke, or other contaminants	6		8		0		0		7		4		5		5	
	TOTALS	31	0	29	0	14	0	37	0	38	0	33	0	53	0	30	0
	MACHINES AND EQUIPMENT																
18	General arrangement conforms to good safety practices	7		2		5		6		9		7		10		8	
19	All stationary machines are securely fastened in place	3		2		5		0		0		7			1		1
20	Machines are located for required process compatibility	5		2		5		10		10		6		10		8	
21	Auxiliary equipment is orderly and readily available	3		6		5		10		10		5		10		7	
22	Work stations are designed to prevent hazards from excess heat or noise	5		7		4		10		8		5		8		0	
23	Work stations are designed to prevent hazards from fire or fumes	7		7		1		10		10		5		10		0	
24	Work stations are designed to prevent hazards from other machines	6		5		4		10		8		5		10		10	
25	Parts of machines needing special caution are color coded	0		0		5		0		0		0		0		0	
26	All machines guards are in proper position for safe machine operation	3		5		8		0		7		4		10		10	
27	Squaring shears are equipped with finger guards		1		1		1		1		1		1		1		1
28	Squaring shears are equipped with foot treadle stops		1		1		1		1		1		1		1		1
29	Jointer knives are equipped with left and right guards		1	0			1		1		1		1		1		1
30	Abrasive wheels are equipped with safety eye shields	6		10		8		0		10			1	10		0	
31	Abrasive wheels are equipped with tool rests	7		10		10		10		10			1	10		10	
32	Abrasive wheels are equipped with guards	7		10		8		10		10			1	10		10	
33	Table saws are equipped with guards and anti-kickback system	6		0		10		0		0		0		10		10	
34	Radial saws are guarded and equipped with anti-kickback device	10		10		5		10			1	6			1	10	

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	Items	School # 26		27		28		29		30		31		32		33	
35	Radial saws are equipped with forward stop and positive saw return	9		0		5		0			1		1		1	10	
36	Machine belts and pulleys are equipped with guards	10		10		10		10		0		6		10			1
37	Piped welding systems have back pressure valves in both lines		1		1		1		1		1		1		1		1
38	Piped welding systems have no quick opening shut off valves		1		1		1		1		1		1		1		1
39	Torches and regulators are in good operating condition	10		10		10		10		10		6		10		10	
40	Hoses are maintained in good condition	10		10		10		10		10		7		10		10	
41	Anti (fire) flashbacks are installed where required in all hoses and lines	0		10		10			1	10		0		10		0	
42	Welding arcs cannot strike cylinders, gas or water lines	10		10		8		10		10		9		10		10	
43	Electrode holders are maintained and stored in good condition	8		10			1	10		8		1	1	10		9	
44	Proper ventilation is provided in welding areas	8		10		0		10		6		2		10		0	
45	All hand-held power tools are equipped with a "dead man" switch	0		0		0		10		0		0		5		10	
46	All electrical apparatus in areas of concentrated vapors are vapor proof		1		1		1		1		1		1		1		1
47	All hoisting devices are in safe operating condition	10			1		1	10			1	2			1	0	
		176	6	173	6	164	8	195	7	176	9	114	11	215	10	175	28
	SAFETY CONDITIONS																
48	Nonskid surfaces are provided around machines	0		0		0		0		0		0		0		0	
49	All welding is done in screened areas	7		10			1	8		0		0		5		0	
50	Cylinders are secured upright and stored in ventilated and clear areas	10		10		5		10		10		8		7		10	
51	Danger zones are properly identified and guarded	0		0		5		0		0		7		6		5	
52	Aisles are clear of protruding objects	8		0		5		7		8		8		10		10	
53	Stairways have unobstructed access		1	10			1		1		1		1		1		1
54	Railings are color coded	0			1		1		1		1		1		1		1
55	Stairways are color coded		1		1		1		1		1		1		1		1
56	Electrical outlets and circuits are properly identified	0		7		5		10		10		2		10		0	
57	Exits are adequately and properly identified	0		0		0		10		0		1		3		10	
58	Walls are clear of hanging objects that might fall	10		0		5		10		10		8		10		0	
59	Utility lines are properly located and identified	8		0		0		10		10		1			1		1
60	A master power switch panel controls all electrical outlets	0		10		0		10		10		1		10		10	
61	Individual machine power switches are installed in power panels	0		7		3		10		10		0		10		10	
62	Extension cords are in good condition (not spliced)	8		10		10		10		10		6		10		0	
63	Extension cords have three-way grounded plugs	10		10		10		5		5		6		10		10	
64	Cables are routed so that they are accessible for inspection and repair	8			1	5		10			1	6			1	10	
65	All switches are enclosed	0		10		7		10		10		7		10		10	
66	No temporary wiring is evident	10		10		0		10		10		7		10		10	
67	The laboratory has eye wash bottles	0		0		0		0		10		7		0		0	
68	The laboratory has chemical spill kits	0		0		0		0		0			1	0		0	
69	The laboratory has safety showers	0		0		0		0		0		7		0		0	
70	An adequately stocked first aid cabinet is provided	0		0		0		0		5		8		5		10	
		265	9	267	11	224	14	345	11	294	15	206	16	336	17	290	33

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N°	Items	School #															
		26		27		28		29		30		31		32		33	
71	Good housekeeping practices are evident	6		0		5		3		6		7		9		7	
72	Benches are kept orderly	8		5		5		3		8		7		10		7	
73	Corners and dead spots are clean and clear	6		0		2		3		6		7		7		8	
74	Special tool racks are in orderly condition at bench and machine sites	0			1	8		3			1	7		10			1
75	Tools, supplies, and/or materials are orderly	7		9		5		3		10		7		10		6	
76	Sufficient scrap boxes are provided	8		0		8		0		0		5		0		0	
77	Materials are stored in an orderly and safe condition	8		9		9		8		6		8		10		8	
		43	0	23	1	42	0	23	0	36	1	48	0	56	0	36	1
	FIRE PROTECTION																
78	Sufficient fire extinguishers are available	10		10		10		10		10		9		10		10	
79	Fire extinguishers are of the proper type	10		10		10		10		10		8		10		10	
80	Fire extinguishers are adequately located, maintained and supplied	10		10		10		10		10		7		10		10	
81	The laboratory has fire detectors	10		10		0		10		0		0		0		0	
82	Spray room doors swing out and cannot be locked from the inside		1		1		1		1		1		1		1		1
83	Storage and waste containers are fire-proof	0		0		0		0		0			1	0		0	
84	Wash tanks for parts that use solvents are fire proof	10		0			1	0			1	1	1	1	1	0	
85	Fire proof storage cabinets are provided for all flammable liquids	0		0		0		10		0			1	0			1
		50	1	40	1	30	2	50	1	30	2	25	4	31	2	30	2
	ERGONOMICS AND SAFETY ENGINEERING																
86	Room furniture and equipment are arranged to avoid accidents	7		5		5		5		10		5		10		0	
87	Aisles are properly located for efficient performance	7		8		3		5		8		5		10		6	
88	The tasks required from students are human factors compatible	10		10		8		10		10		5		10		10	
89	Dials, controls and displays conform to human factors standards	8		10		8		10		10		5		10		10	
90	There is local or direct lighting for equipment where needed	8		5		7		10		10		1		10		10	
91	The work areas are free from direct or reflected glare sources	7		5		8		10		7		3		9		10	
92	The work areas are free from evident sharp edges or trip hazards	7		8		5		10		7		5		8		7	
93	The work areas are free from evident slip and fall hazards	8		10		5		10		7		5		9		7	
94	Tool racks are available where needed	0			1	8		10			1	7		10			1
95	Areas for teaching and demonstration are available	8		9		8		10		10		9		10		10	
96	Work stations are designed to prevent hazards from passing students	7		5		7		10		8		8		10		10	
97	Work stations are designed to protect observing students from hazards	7		8		7		10		8		7		10		0	
98	Safety instructions for use of each machine are posted or readily available	0		0		7		0		0		0		10		5	
99	All machine switches are within easy reach of the operators	9		10		8		10		10		8		10		10	
100	A visible "off" position is located on each machine	9		10		9		10		10		3		10		10	
101	Machines are located in such way that operator space is adequate	6		4		7		10		8		4		10		10	
102	Machines are located in such a way that required supervision is possible	10		10		8		10		8		9		10		10	
103	Master and other power panels are easily accessible	5		10		7		10		10		9		7		10	
		123	0	127	1	125	0	160	0	141	1	98	0	173	0	135	1

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Nº	Items	School #															
		26		27		28		29		30		31		32		33	
	SCHOOL SAFETY POLICIES AND PROCEDURES																
104	A safety policy or rules are enforced for safe shop operation	10		10		10		10		10		10		10		10	
105	Number of laboratory groups are kept appropriate for the respective work	0		0		0		0		10		10		10		10	
106	Laboratory areas are provided with custodial services	0		0		0		0		0		0		0		0	
107	The school uses the services of a safety inspector or advisor	0		0		0		0		10		10		0		0	
108	The school promotes and organizes safety contests	10		0		0		0		0		0		0		0	
109	Emergency procedures have been established for emptying the facilities	10		10		10		10		10		10		10		10	
110	All safety procedures are posted conspicuously near all areas of operatio	10		0		0		0		0		0		10		0	
111	The school has access to qualified individuals to administer first aid	10		0		10		0		10		10		10		0	
112	Instructors are First Aid certified	0		0		0		0		0		0		0		0	
113	The school has a policy and/or procedure for the administration of first aid	10		0		10		10		10		10		0		10	
		60	0	20	0	40	0	30	0	60	0	60	0	50	0	40	0
	GENERAL SAFETY PRACTICES																
114	Routine preventative maintenance is practiced	10		10		10		10		10		10		10		10	
115	All maintenance problems and requests for improvement are recorded	10		10		10		0		10		10		10		0	
116	Facilities are inspected regularly for hazards and needed corrections	0		10		10		10		10		10		10		0	
117	An inspection checklist is used when making the above inspections	0		0		0		0		10		10		0		0	
118	All defective equipment and hazards are reported immediately	10		10		10		10		10		10		10		10	
119	Records of all inspections are readily available for reference	0		0		10		0		10		10		0		0	
120	Safety inspections of the shop are also made by a student safety committ	0		0		0		0		0		0		0		0	
121	Students are rotated on the student safety committee	0		0			1	0		0		0		0		0	
122	Lockers are inspected regularly for cleanliness and fire hazards	10		10			1	0			1		1		1	0	
123	Locker doors are kept closed	10		0			1	10			1		1		1	10	
124	One instructor has the overall responsibility for each major facility	10		10		10		10		10		10		10		10	
125	Instructor supervision is provided at all times during laboratory sessions	10		10		10		10		10		10		10		10	
126	All main power switches are " off " when laboratories are not in session	0		0		10		0		0		0		0		10	
127	All machines are shut off when the instructor is out of the laboratory	10		10		10		10		10		10		10		10	
128	All machines are shut off while unattended	10		10		10		10		10		10		10		10	
129	All machines are off and tagged when being cleaned or adjusted	0		10		10		10		10		10		10		0	
130	Continuous proper examples are practiced by the instructor	10		10		10		10		10		10		10		10	
131	All accidents are reported for immediate attention and analysis	10		10		10		10		10		10		10		10	
132	All accident analyses are used to implement prompt corrective measures																
133	Activities are selected based on students' ability & maturation level																
134	Machine operation instructions are posted or available near areas of operation																
135	Tools are kept sharp, clean, and in safe working order																
136	Materials being worked are secured when the operation so demands	10		10		10		10		10		10		10		10	
137	All work undertaken is approved through an established method	10		10		10		0		10		10		10		10	
138	Proper warnings are given in using toxics, caustics and volatile materials		1	10		10		10		10			1	10		0	
139	The school promotes and develops the sense of safety consciousness	10		10		10		0		10		10		0		10	
140	Questions on safety are included in the instructional program	10		10		10		10		10		10		10		10	

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Nº	Items	School #															
		26		27		28		29		30		31		32		33	
141	Printed safety rules are given to each student	10		10		10		10		0		10		10		10	
142	Motion and/or slide films on safety are used in the instruction	10		10		10		10		0		10		10		10	
143	Occasional talks on safety are given by industry or outside specialists	10		10		0		10		0		10		10		0	
144	Students that constantly violate safety regulations are removed from class	0		10		10		0		10		10		0		0	
145	Dangerous horseplay and practical jokes are prohibited	10		10		10		10		10		10		10		10	
146	A proper record is kept of safety instruction given	10		0		10		10		0		10		10		10	
147	Inappropriate garments or other materials are kept out of activity areas	10		10		10		10		10		10		10		10	
148	Safety bulletin boards and posters are part of the total safety program	10		10		10		0		10		0		10		10	
149	Only spark lighters are used to light torches	10		10		10		0		10		10		10		10	
150	Safety cans are provided for storing flammable liquids		1	10		0		0		10		10		0		0	
151	Students are tested for safety knowledge	10		10		10		10		10		10		10		10	
152	Students are tested for safety ability	10		10		10		10		10		10		10		10	
153	Students are instructed in methods for handling and lifting materials	10		10		10		10		10		10		10		10	
154	Students are instructed to clear off machines before turning them on	10		10		10		10		10		10		10		10	
155	Students are instructed never to leave a machine while it is in operation	10		10		10		10		10		10		10		10	
156	Students are instructed never to stop moving parts of a machine by hand	10		10		10		10		10		10		10		10	
157	Students are instructed to stay clear of other operating machines	10		10		10		10		10		10		10		10	
158	Students are instructed not to annoy or alarm an operator	10		10		10		10		10		10		10		10	
159	Students are instructed in the use of the tools and equipment they operate	10		10		10		10		10		10		10		10	
160	Students are tested and authorized before operating machines	10		10		10		10		10		10		10		10	
161	Students are alerted and monitored for possible hazardous operations	10		10		10		10		10		10		10		10	
162	Students are instructed as to how to report hazards and fires	10		10		10		10		10		10		10		10	
163	Students sleeves are rolled above elbows when operating machines		1	0		0		0		10		10		0		10	
164	Students avoid the use of loose clothing, jewelry, ties, long hair, etc.	10		10		10		10		10		10		10		10	
165	The students are not exposed to unreasonable environmental changes	10		0		10		10		10		10		10		10	
166	Noise from laboratory or other sources do not annoy or distract students	10		0		0		10		10		10		10		0	
167	Scrap stock is promptly put in scrap boxes	10		0		10		0		0		10			1	0	
168	Containers for oily rags are frequently emptied	10		10		10		10			1	10		0		0	
169	Waste (shavings, sawdust, paint, etc.) is disposed of daily	10		0		10		0		10		10		0		10	
170	Machines are kept in safe operating condition at all times	10		10		10		10		10		10		10		10	
171	Temperature control for all seasons is adequate	10		0		10		10		10		0		0		0	
172	Noise is always kept within acceptable levels at all laboratory locations	10		10		0		0		10		10		0		0	
173	Proper tools and materials are always available for machine cleaning	10		10		10		10		0		0		10		10	
174	All guards are used at all times	10		0		10		0		0		0		10		10	
175	Signs are always secured to machines that are out of order	0		10		10		10			1	0		10		0	
176	Power panel switches are always "off" when machines are out of order	0		0		10		10		0		10		10		10	
177	Compressed air is always reduced to 30 psi when used for cleaning	10		10			1	10			1		1	10		10	
178	Compressed air is always provided with proper tip when used for cleanin	10		10			1	10			1		1	10		10	
179	Extension cords are always avoided as permanent installations	10		10		10		10		10		10		10		0	

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Nº	Items	School #															
		26		27		28		29		30		31		32		33	
180	Arc welding is always done only in dry areas	10		10			1	10		10		10		10		10	
181	Welding is always done only in areas free of combustible materials	10		10			1	10		10		10		10		10	
182	Fire proof bulk storage is provided outside the facilities	0		0			1	0		0		0		0		10	
183	All waste and oily rags are always placed in the correct containers	10		10		10		0			1	10		10		0	
184	Noise levels never affect speech intelligibility or present a health hazard	10		10		0		0		10		10		0		0	
185	There are not unusual human factors incompatibilities for working student	10		0		10			1	10		10		10		0	
186	Reflective screens are always used as protection from arc flashes and bu	10		10			1	0		0		0		10		10	
187	The laboratory keeps an inventory of all chemicals used		1		1	0		0			1	0		0		0	
188	The laboratory uses materials safety handling sheets		1		1	0		0		0			1	0		10	
189	The instructors are certified in handling chemicals	10			1	10		10		10			1	0		0	
190	The instructor (s) has (have) 40 hour hazardous waste training	10			1	0		0		0			1	0		0	
191	The laboratory is inspected for safety on a monthly basis	10		10		10		0		10		0		0		0	
192	The laboratory has procedures for dealing with chemical spills		1		1	0		0		0			1	0		0	
193	The laboratory has a planned response for chemical spills		1		1	0		0		0			1	0		0	
		580	7	530	6	540	9	470	1	510	8	540	10	510	3	480	47
	PERSONAL PROTECTIVE EQUIPMENT																
194	Personal protective equipment is washed and disinfected as needed	10		10		10		10		10			1	0		0	
195	Provisions are made for cleaning and disinfecting of respirators		1	0			1	10			1		1	0		0	
196	Eye-wash baths and showers are available when using caustic materials		1	0		0		0			1	10		0		0	
197	Eye-protective devices are disinfected & returned to proper racks after us	0		10		10		10		0		10		0		0	
198	Observers use acceptable protection	10		10		10		10		10		10		10		0	
199	Protective clothing (aprons, shoes, gloves, etc.) are used when required	10		10		10		10		10		10		10		10	
200	Respiration and noise suppression devices are used as required	10		0		0		0		0		0		10		10	
201	Eye protection devices are worn when required	10		10		10		10		10		10		10		10	
202	Shields are provided for electric welding	10		10			1	10		10		10		10		10	
203	Goggles with the proper lenses are used when torch welding	10		10		10		10		10		10		10		10	
204	An arc-welding helmet with correct lenses is used when electric welding	10		10			1	10		10		10		10		10	
		80	2	80	0	60	3	90	0	70	2	80	2	70	0	60	0
	FIRE PROTECTION																
205	Instructors are knowledgeable in the use of the fire extinguishers	10		10		10		10		10		10		10		10	
206	Instructors know the procedures in the event of fire	10		10		10		10		10		10		10		10	
207	Filters in spray booths are replaced regularly	10			1		1		1		1		1		1		1
208	Students know the location and use of the various fire extinguishers	10		10		10		10		0		10		0		10	
209	Students are instructed on the basics of fire prevention	10		10		10		10		10		10		10		10	
210	Students are instructed as to how to report fires	10		10		10		10		10		10		0		10	
		60	0	50	1	50	1	50	1	40	1	50	1	30	1	50	1

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	Items	School #															
		34		35		36		37		38		39		40		41	
1	General appearance is conducive to student safety	10		7		7		10		8		8		5		10	
2	Floors are kept in a condition conducive to student safety	10		10		9		10		7		8		5		10	
3	Walls and ceilings are kept in a condition conducive to student safety	10		10		10		10		8		8		5		10	
4	The facilities are free from evident architectural barriers	10		10		10		10		7		10		5		10	
5	There are sufficient exits in each laboratory	10		10		10		10		10		10		10		10	
6	Storage space for tools and materials is adequate	10		6		10		10		10		6		0		6	
7	Storage space for equipment and materials being worked on is adequate	10		4		5		10		10		6		0		10	
8	Stairways have safe treads and risers		1		1	7			1		1		1		1		1
9	Stairways have approved railings		1		1	10			1		1		1		1		1
10	Mezzanines are protected with toe boards or railings		1		1	10			1		1		1		1		1
11	The facilities are wheelchair accessible (including laboratories)	10		10		10		10		0		10		5		10	
	TOTALS	80	3	67	3	98	0	80	3	60	3	66	3	35	3	76	3
	ENVIRONMENT																
12	Facilities are pleasant & conducive to student safety	10		10		10		10		10		8		0		9	
13	Facilities are clean and orderly	8		9		6		8		10		8		5		10	
14	The area or square feet of laboratory per student is adequate	10		6		3		10		10		8		0		0	
15	Illumination is sufficient and non glare lighting is provided for all work area	10		8		10		10		10		10		10		10	
16	Ventilation is adequate and proper for conditions	10		2		10		10		8		10		10		10	
17	Air is free from dust, smoke, or other contaminants	8		2		10		10		6		10		5		10	
	TOTALS	56	0	37	0	49	0	58	0	54	0	54	0	30	0	49	0
	MACHINES AND EQUIPMENT																
18	General arrangement conforms to good safety practices	10		10		10		7		10			1	10		10	
19	All stationary machines are securely fastened in place	10			1	0		8		8			1	0		0	
20	Machines are located for required process compatibility	10		9		10		9		8			1	10		10	
21	Auxiliary equipment is orderly and readily available	2		10		7		8		8			1	10		10	
22	Work stations are designed to prevent hazards from excess heat or noise	10		9		10		9		9			1	0		10	
23	Work stations are designed to prevent hazards from fire or fumes	10		10		10		10		8			1	0		10	
24	Work stations are designed to prevent hazards from other machines	10		10		10		10		9			1	0			1
25	Parts of machines needing special caution are color coded	0			1	0		5		10			1	10		0	
26	All machines guards are in proper position for safe machine operation	0		10		8		10		7			1	10		0	
27	Squaring shears are equipped with finger guards		1		1		1		1		1		1		1		1
28	Squaring shears are equipped with foot treadle stops		1		1		1		1		1		1		1		1
29	Jointer knives are equipped with left and right guards		1		1		1		1	0			1		1		1
30	Abrasive wheels are equipped with safety eye shields		1		1	10		10		10			1	10		10	
31	Abrasive wheels are equipped with tool rests		1		1	10		10		10			1	10		10	
32	Abrasive wheels are equipped with guards		1		1	10		10		10			1	10		10	
33	Table saws are equipped with guards and anti-kickback system		1		1	0			1	0			1	10		10	
34	Radial saws are guarded and equipped with anti-kickback device		1		1	10			1	10			1		1	5	

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	Items	School #															
		34		35		36		37		38		39		40		41	
35	Radial saws are equipped with forward stop and positive saw return		1		1	0			1	10			1		1	10	
36	Machine belts and pulleys are equipped with guards	0			1	10			1	10			1	10		0	
37	Piped welding systems have back pressure valves in both lines		1		1		1		1		1		1		1		1
38	Piped welding systems have no quick opening shut off valves		1		1		1		1		1		1		1		1
39	Torches and regulators are in good operating condition	10		10		10		10		10			1	10		10	
40	Hoses are maintained in good condition	10		10		10		10		10			1	10		10	
41	Anti (fire) flashbacks are installed where required in all hoses and lines		1	10		0		10		0			1	10		10	
42	Welding arcs cannot strike cylinders, gas or water lines	10		10		10		10		10			1	10		10	
43	Electrode holders are maintained and stored in good condition	10		10		10		7		7			1	10		10	
44	Proper ventilation is provided in welding areas	10		8		10		10		4			1	10		10	
45	All hand-held power tools are equipped with a "dead man" switch	10		1		10			1	8			1	0		0	
46	All electrical apparatus in areas of concentrated vapors are vapor proof		1		1		1		1	8			1		1		1
47	All hoisting devices are in safe operating condition		1		1		1		1	10			1		1		1
		156	14	162	16	211	7	200	12	242	4	39	30	200	9	206	34
	SAFETY CONDITIONS																
48	Nonskid surfaces are provided around machines	0			1	0		0		8			1	0		0	
49	All welding is done in screened areas	0		8		7		10		0			1	0		10	
50	Cylinders are secured upright and stored in ventilated and clear areas	10		10		10		10		10			1	10		8	
51	Danger zones are properly identified and guarded	0		10		10		7		10			1	0		0	
52	Aisles are clear of protruding objects	10		10		7		9		10		10		10		10	
53	Stairways have unobstructed access		1		1	10			1		1		1		1		1
54	Railings are color coded		1		1	0			1		1		1		1		1
55	Stairways are color coded		1		1	0			1		1		1		1		1
56	Electrical outlets and circuits are properly identified	10		10		5		7		10		0		0		10	
57	Exits are adequately and properly identified	10		10		5		10		7		0		10		10	
58	Walls are clear of hanging objects that might fall	10		10		10		10		10		10		0		10	
59	Utility lines are properly located and identified	10		10		10		0		10		0		0		0	
60	A master power switch panel controls all electrical outlets	10		10		0		10		10		10		10		10	
61	Individual machine power switches are installed in power panels	10		10		10		10		10			1	10		10	
62	Extension cords are in good condition (not spliced)	10		10		7		10			1		1	10		10	
63	Extension cords have three-way grounded plugs	10		10		10		10			1		1	10		10	
64	Cables are routed so that they are accessible for inspection and repair		1		1	10		10		10			1	10			1
65	All switches are enclosed	10		6		9		10		10		10		10		10	
66	No temporary wiring is evident	10		10		10		10		10		10		10		8	
67	The laboratory has eye wash bottles	0		0		0		0		0		0		0		0	
68	The laboratory has chemical spill kits	0		0		0			1	0		0		0		0	
69	The laboratory has safety showers	0		0		0		0		10		0		0		0	
70	An adequately stocked first aid cabinet is provided	0		7		10		0		10		0		0		10	
		286	20	304	23	361	9	333	19	413	9	89	44	300	14	332	40

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(Appendix C con'd)

N°	Items	School #															
		34		35		36		37		38		39		40		41	
71	Good housekeeping practices are evident	8		9		7		7		10		8		0		10	
72	Benches are kept orderly	10			1	7		7		10		10		10		10	
73	Corners and dead spots are clean and clear	10		9		6		7		10		8		0		0	
74	Special tool racks are in orderly condition at bench and machine sites	10		9		10		7		8		10		0			1
75	Tools, supplies, and/or materials are orderly	10		9		7		8		8		10		10		10	
76	Sufficient scrap boxes are provided	0		10		10		10		10		10		0		10	
77	Materials are stored in an orderly and safe condition	10		8		10		8		10		10		5		10	
		58	0	54	1	57	0	54	0	66	0	66	0	25	0	50	1
	FIRE PROTECTION																
78	Sufficient fire extinguishers are available	10		10		10		0		10		0		10		10	
79	Fire extinguishers are of the proper type	10		10		10		0		10			1	10		10	
80	Fire extinguishers are adequately located, maintained and supplied	10		10		10		0		10			1	10		10	
81	The laboratory has fire detectors	10		1		10		10		0			1	0		0	
82	Spray room doors swing out and cannot be locked from the inside		1		1		1	0			1		1		1		1
83	Storage and waste containers are fire-proof	0			1	10		0		0			1	0		10	
84	Wash tanks for parts that use solvents are fire proof	0		1	1	1	1	1	1	1	1	1	1	1	1		1
85	Fire proof storage cabinets are provided for all flammable liquids	0		1		0			1	0			1	0		10	
		40	1	33	3	51	2	11	2	31	2	1	7	31	2	50	2
	ERGONOMICS AND SAFETY ENGINEERING																
86	Room furniture and equipment are arranged to avoid accidents	10		9		10		10		10		10		5		10	
87	Aisles are properly located for efficient performance	10		10		10		10		10		10		5		10	
88	The tasks required from students are human factors compatible	10		10		10		10		10		10		10		10	
89	Dials, controls and displays conform to human factors standards	10		10		10		10		10			1	10			1
90	There is local or direct lighting for equipment where needed	10		10		10		10		10			1	10		8	
91	The work areas are free from direct or reflected glare sources	10		10		10		10		10		10		10		10	
92	The work areas are free from evident sharp edges or trip hazards	10		10		8		8		10		10		10		8	
93	The work areas are free from evident slip and fall hazards	6		10		10		9		10		10		5		10	
94	Tool racks are available where needed	8		10		10		10		8			1	10			1
95	Areas for teaching and demonstration are available	10		10		10		10		10		6		5		10	
96	Work stations are designed to prevent hazards from passing students	10		10		10		10		10		10		0		10	
97	Work stations are designed to protect observing students from hazards	10		9		10		10		10		10		0		10	
98	Safety instructions for use of each machine are posted or readily available		7	9		10		8		7			1	0		10	
99	All machine switches are within easy reach of the operators	10		10		10		10		10			1	10		10	
100	A visible "off" position is located on each machine	10		10		10		10		10			1	10		10	
101	Machines are located in such way that operator space is adequate	10		10		10		10		10			1	0		10	
102	Machines are located in such a way that required supervision is possible	10		10		10		5		10			1	5		10	
103	Master and other power panels are easily accessible	10		5		10		8		10		6		10		10	
		164	7	172	0	178	0	168	0	175	0	92	8	115	0	156	2

First column of each school = Field Safety Rating
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Nº	Items	School #															
		34		35		36		37		38		39		40		41	
	SCHOOL SAFETY POLICIES AND PROCEDURES																
104	A safety policy or rules are enforced for safe shop operation	10		10		10		10		10		10		10		10	
105	Number of laboratory groups are kept appropriate for the respective work	10		0		10		10		10		10		0		0	
106	Laboratory areas are provided with custodial services	0		0		10		0		0		10		0		10	
107	The school uses the services of a safety inspector or advisor	0		0		0		0		0		0		0		10	
108	The school promotes and organizes safety contests	0		0		0			1	10		0		0		0	
109	Emergency procedures have been established for emptying the facilities	10		10		10		10		10		10		10		10	
110	All safety procedures are posted conspicuously near all areas of operatio	0		10		10		10		10		0		0		10	
111	The school has access to qualified individuals to administer first aid	10		10		10			1	10		10		10		10	
112	Instructors are First Aid certified	0		10		10			1	10		0		0		0	
113	The school has a policy and/or procedure for the administration of first aid	10		10		10		10		10		10		0		10	
		50	0	60	0	80	0	50	3	80	0	60	0	30	0	70	0
	GENERAL SAFETY PRACTICES																
114	Routine preventative maintenance is practiced	10		10		10		10		10		10		10		10	
115	All maintenance problems and requests for improvement are recorded	0		10		0		10		10		0		0		10	
116	Facilities are inspected regularly for hazards and needed corrections	10		10		10		10		10		0		10		10	
117	An inspection checklist is used when making the above inspections	0		10		0		0		10			1	0		10	
118	All defective equipment and hazards are reported immediately	10		10		10		10		10		10		10		10	
119	Records of all inspections are readily available for reference	0		10		0		10			1		1	0		10	
120	Safety inspections of the shop are also made by a student safety committ	0		0		10		0		0		0		0		0	
121	Students are rotated on the student safety committee		1	0		10		0		0			1	0		0	
122	Lockers are inspected regularly for cleanliness and fire hazards		1		1		1	10			1		1		1	0	
123	Locker doors are kept closed		1		1		1	0			1		1		1	10	
124	One instructor has the overall responsibility for each major facility	0		10		10		10		10		10		0		10	
125	Instructor supervision is provided at all times during laboratory sessions	10		10		10		10		10		10		10		10	
126	All main power switches are " off " when laboratories are not in session	0		0		0		0		0			1	0		10	
127	All machines are shut off when the instructor is out of the laboratory	0		0		10		10		10			1	10		0	
128	All machines are shut off while unattended	10		10		10		10		10			1	10		10	
129	All machines are off and tagged when being cleaned or adjusted	10		10		10		0		10			1	10		10	
130	Continuous proper examples are practiced by the instructor	10		10		10		10		10		10		10		10	
131	All accidents are reported for immediate attention and analysis	10		10		10		10		10		10		10		10	
132	All accident analyses are used to implement prompt corrective measures																
133	Activities are selected based on students' ability & maturation level																
134	Machine operation instructions are posted or available near areas of operation																
135	Tools are kept sharp, clean, and in safe working order																
136	Materials being worked are secured when the operation so demands	10		10		10		10		10		10		10		10	
137	All work undertaken is approved through an established method	10		10		10		10		10		10		10		10	
138	Proper warnings are given in using toxics, caustics and volatile materials	10		10			1	0			1		1	10		10	
139	The school promotes and develops the sense of safety consciousness	10		10		10		10		10		10		10		10	
140	Questions on safety are included in the instructional program	10		10		10		10		10		10		10		10	

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Nº	Items	School #															
		34		35		36		37		38		39		40		41	
141	Printed safety rules are given to each student	10		10		10		0		10		10		10		10	
142	Motion and/or slide films on safety are used in the instruction	0		10		10		10		10		0		10		10	
143	Occasional talks on safety are given by industry or outside specialists	0		10		0		10		10		0		0		0	
144	Students that constantly violate safety regulations are removed from class	0		10		10		10		10		10		0		10	
145	Dangerous horseplay and practical jokes are prohibited	10		10		10		10		10		10		10		10	
146	A proper record is kept of safety instruction given	0		10		10		10		10		10		10		10	
147	Inappropriate garments or other materials are kept out of activity areas	10		10		10		10		10		10		10		10	
148	Safety bulletin boards and posters are part of the total safety program	0		10		0		10		10		10		0		0	
149	Only spark lighters are used to light torches	10		10		10		10		10		10		10		10	
150	Safety cans are provided for storing flammable liquids	0			1	10			1		1		1	0		10	
151	Students are tested for safety knowledge	10		10		10		10		10		10		10		10	
152	Students are tested for safety ability	0		10		10		10		10		10		10		10	
153	Students are instructed in methods for handling and lifting materials	10		10		10		10		10		0		10		0	
154	Students are instructed to clear off machines before turning them on	10		10		10		10		10			1	10		10	
155	Students are instructed never to leave a machine while it is in operation	10		10		10		10		10			1	10		10	
156	Students are instructed never to stop moving parts of a machine by hand	10		10		10		10		10			1	10		10	
157	Students are instructed to stay clear of other operating machines	10		10		10		10		10			1	10		10	
158	Students are instructed not to annoy or alarm an operator	10		10		10		10		10			1	10		10	
159	Students are instructed in the use of the tools and equipment they operate	10		10		10		10		10		10		10		10	
160	Students are tested and authorized before operating machines	10		10		10		10		10		10		10		10	
161	Students are alerted and monitored for possible hazardous operations	10		10		10		10		10		10		10		10	
162	Students are instructed as to how to report hazards and fires	10		10		10		10		10		10		10		10	
163	Students sleeves are rolled above elbows when operating machines	10		10		0		0		10			1	10		10	
164	Students avoid the use of loose clothing, jewelry, ties, long hair, etc.	10		10		10		10		10			1	10		10	
165	The students are not exposed to unreasonable environmental changes	10		10		10		10		10		10		10		10	
166	Noise from laboratory or other sources do not annoy or distract students	0		10		10		10		10		0		10		10	
167	Scrap stock is promptly put in scrap boxes	0		10		10		10		10		10		10		10	
168	Containers for oily rags are frequently emptied	10			1	10			1		1		1	10		10	
169	Waste (shavings, sawdust, paint, etc.) is disposed of daily	0		10		0			1	10		10		10		10	
170	Machines are kept in safe operating condition at all times	0		10		10		10		10			1	10		10	
171	Temperature control for all seasons is adequate	0		0		10		10		0		10		10		10	
172	Noise is always kept within acceptable levels at all laboratory locations	10		10		10		10		0		10		10		10	
173	Proper tools and materials are always available for machine cleaning	0		0		10		10		10			1	10		10	
174	All guards are used at all times	0		10		0		10		10			1	10		10	
175	Signs are always secured to machines that are out of order	0		10		10		0		10			1	10		10	
176	Power panel switches are always "off" when machines are out of order	10		10		10		0		10			1	10		10	
177	Compressed air is always reduced to 30 psi when used for cleaning		1		1		1		1	0		10		10			1
178	Compressed air is always provided with proper tip when used for cleaning		1		1		1		1	10		10		10			1
179	Extension cords are always avoided as permanent installations	10		10		10		10		0		10		10		0	

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N°	Items	School #															
		34		35		36		37		38		39		40		41	
180	Arc welding is always done only in dry areas	10		10		10		10		10			1	10		10	
181	Welding is always done only in areas free of combustible materials	10		10		10		10		10			1	10		10	
182	Fire proof bulk storage is provided outside the facilities	0			1	0		0			1		1	10		10	
183	All waste and oily rags are always placed in the correct containers	0			1	10		10			1		1	10		10	
184	Noise levels never affect speech intelligibility or present a health hazard	10		0		10		10		10			1	10		10	
185	There are not unusual human factors incompatibilities for working students	10		10		10		10		10		0		10		10	
186	Reflective screens are always used as protection from arc flashes and bur	0		0		10		10		10			1	0		10	
187	The laboratory keeps an inventory of all chemicals used	0			1	10			1		1	0		10		0	
188	The laboratory uses materials safety handling sheets	0			1	0		10		10		0		10		10	
189	The instructors are certified in handling chemicals	0			1	10			1	10		0			1	10	
190	The instructor (s) has (have) 40 hour hazardous waste training	0			1	0			1	0		0			1	0	
191	The laboratory is inspected for safety on a monthly basis	0			1	0		10		0		0		10		10	
192	The laboratory has procedures for dealing with chemical spills	0			1	0			1	0		0		10			1
193	The laboratory has a planned response for chemical spills	0			1	0			1		1	0			1		1
		390	5	530	15	560	5	540	10	560	10	310	30	590	5	620	63
	PERSONAL PROTECTIVE EQUIPMENT																
194	Personal protective equipment is washed and disinfected as needed	0		0		10		10			1		1	10		10	
195	Provisions are made for cleaning and disinfecting of respirators		1		1		1		1		1		1	10			1
196	Eye-wash baths and showers are available when using caustic materials	10		0			1		1	10			1	0		0	
197	Eye-protective devices are disinfected & returned to proper racks after use	0		10		10		10		10		0		0		10	
198	Observers use acceptable protection	10		10		10		10		10		10		10		10	
199	Protective clothing (aprons, shoes, gloves, etc.) are used when required	10		10		10		10		10		10		10		10	
200	Respiration and noise suppression devices are used as required	0		10			1	10		10			1	0			1
201	Eye protection devices are worn when required	10		10		10		10		10		10		10		10	
202	Shields are provided for electric welding	10		10		10		10		10			1	10		10	
203	Goggles with the proper lenses are used when torch welding	10		10		10		10		10			1	10		10	
204	An arc-welding helmet with correct lenses is used when electric welding	10		10		10		10		10			1	10		10	
		70	1	80	1	80	3	90	2	90	2	30	7	80	0	80	2
	FIRE PROTECTION																
205	Instructors are knowledgeable in the use of the fire extinguishers	10		10		10		10		10		10		10		10	
206	Instructors know the procedures in the event of fire	10		10		10		10		10		10		10		10	
207	Filters in spray booths are replaced regularly		1		1		1		1		1		1		1	10	
208	Students know the location and use of the various fire extinguishers	10		0		10		10		10		0		10		10	
209	Students are instructed on the basics of fire prevention	10		10		10		10		10		0		10		10	
210	Students are instructed as to how to report fires	10		10		10		10		10		10		0		10	
		50	1	40	1	50	1	50	1	50	1	30	1	40	1	60	0

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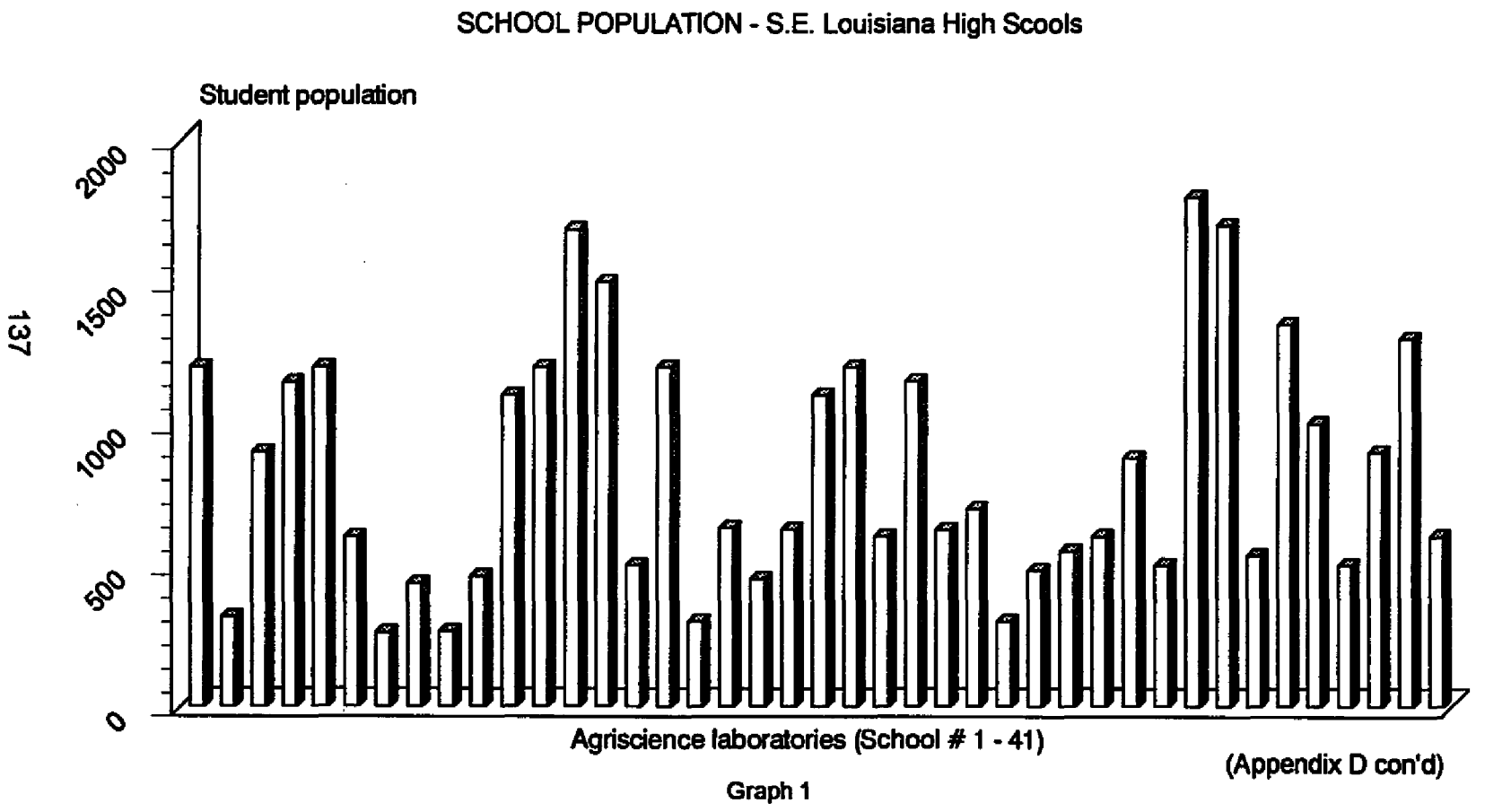
APPENDIX D
DEMOGRAPHIC DISTRIBUTIONS

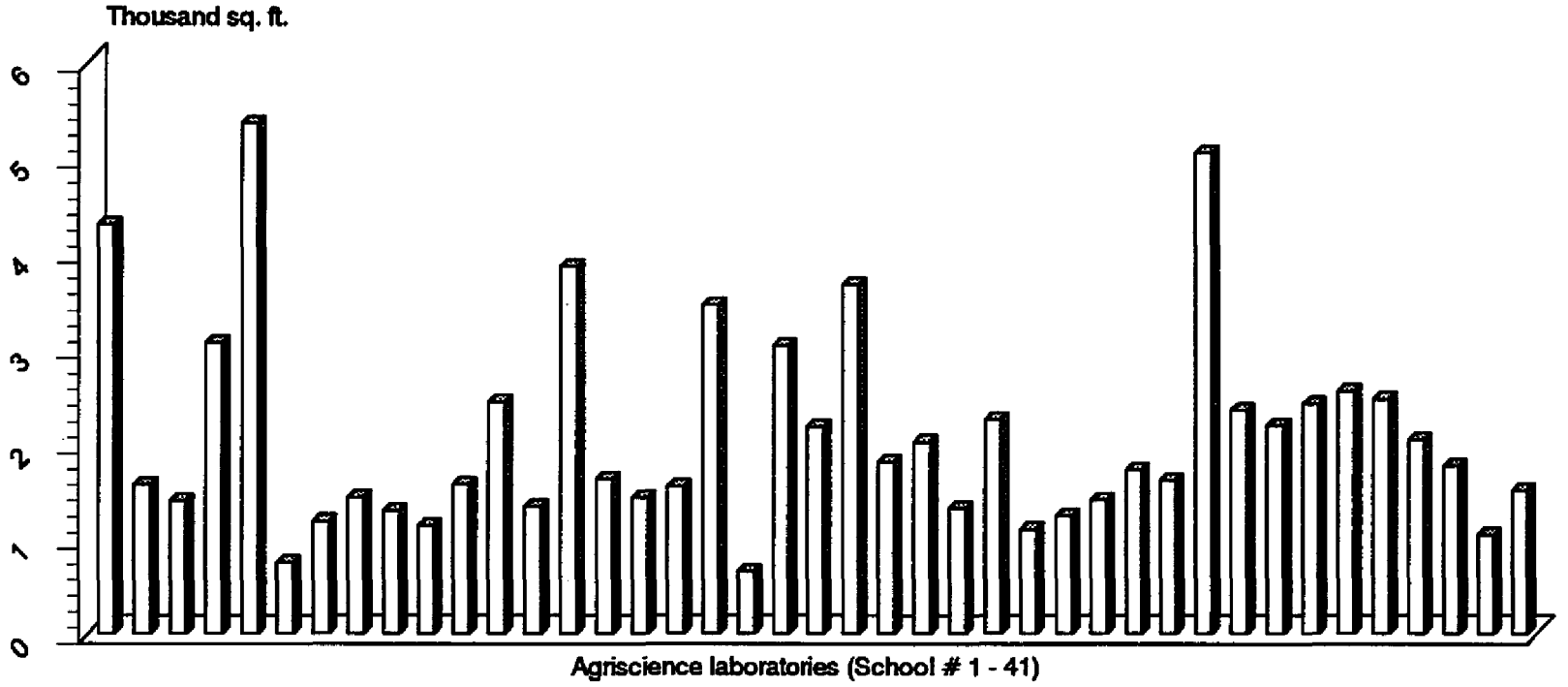


Graph 1

(Appendix D con'd)

AGRISCIENCE LABORATORY AREAS

S.E. Louisiana High Schools

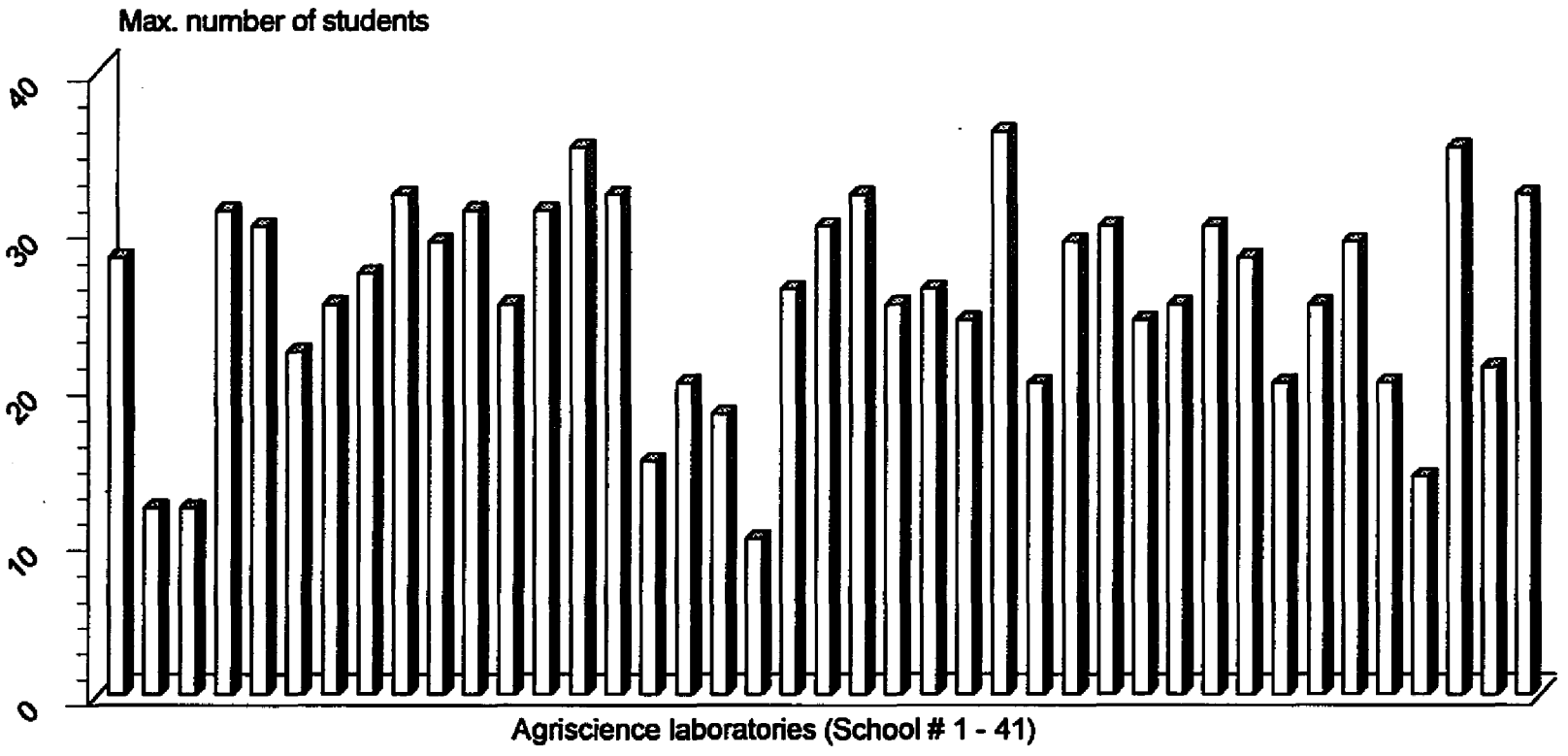


Graph 2

(Appendix D con'd)

MAX. NUMBER OF STUDENTS PER LAB. SESSION

S.E. Louisiana High Schools

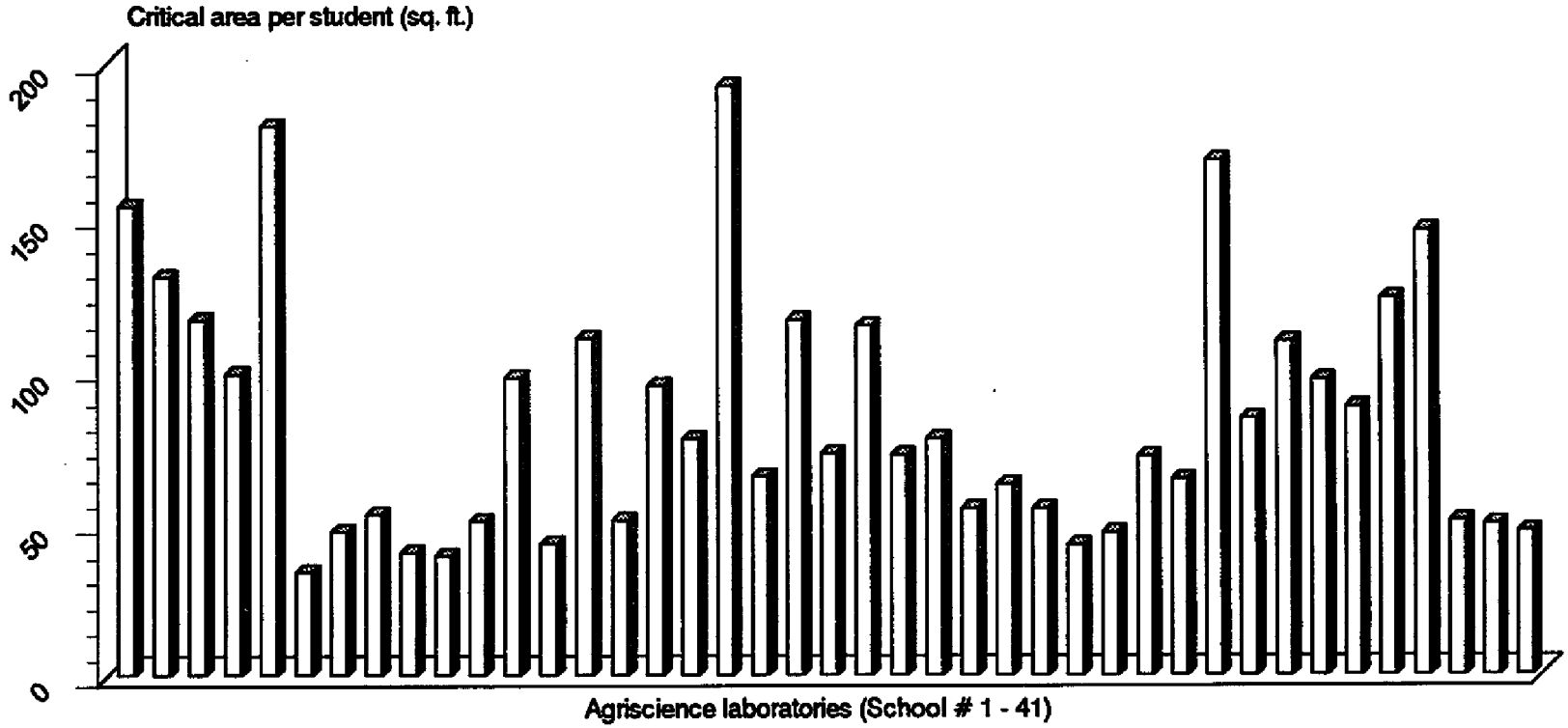


Graph 3

(Appendix D con'd)

CRITICAL AREA OF LAB. PER STUDENT IN LAB. SESSION

S.E. Louisiana High Schools



Graph 4

APPENDIX E
EVALUATIONS FOR SAFETY IMPORTANCE

Columns 1 - 6 represent the different evaluations made by six campus safety experts
The last column is the average of the six evaluations

Scale: 1 - 5 ascending

N°	ITEMS	1	2	3	4	5	6	Avg
	BUILDING							
1	General appearance is conducive to student safety	5	3	3	5	3	4	3.8
2	Floors are kept in a condition conducive to student safety	5	5	3	5	3	4	4.2
3	Walls and ceilings are kept in a condition conducive to student safety	1	4	3	5	2	3	3.0
4	The facilities are free from evident architectural barriers	2	4	3	4	2	3	3.0
5	There are sufficient exits in each laboratory	3	5	5	4	3	5	4.2
6	Storage space for tools and materials is adequate	3	4	4	4	4	4	3.8
7	Storage space for equipment and materials being worked on is adequate	3		4	4	4	4	3.8
8	Stairways have safe treads and risers	1	4	3	5	3	4	3.3
9	Stairways have approved railings	1	2	3	5	3	4	3.0
10	Mezzanines are protected with toe boards or railings	1	5	3	4	3	3	3.2
11	The facilities are wheelchair accessible (including laboratories)	2	2	3	3	1	3	2.3
	ENVIRONMENT							
12	Facilities are pleasant & conducive to student safety	4	3	3	4	3	3	3.3
13	Facilities are clean and orderly	4	4	3	5	4	3	3.8
14	The area or square feet of laboratory per student is adequate	4	3	4	5	2	3	3.5
15	Illumination is sufficient and non glare lighting is provided for all work areas	4	4	4	4	3	4	3.8
16	Ventilation is adequate and proper for conditions	5	5	5	4	4	4	4.5
17	Air is free from dust, smoke, or other contaminants	4	5	5	4	3	3	4.0
	MACHINES & EQUIPMENT							
18	General arrangement conforms to good safety practices	2	3	4	5	3	4	3.5
19	All stationary machines are securely fastened in place	2	3	4	4	3	3	3.2
20	Machines are located for required process compatibility	2	2	4	2	3	4	2.8
21	Auxiliary equipment is orderly and readily available	2	3	4	2	3	3	2.8
22	Work stations are designed to prevent hazards from excess heat or noise	2	4	5	5	3	3	3.7
23	Work stations are designed to prevent hazards from fire or fumes	3	5	5	5	3	4	4.2
24	Work stations are designed to prevent hazards from other machines	4	5	5	5	3	3	4.2
25	Parts of machines needing special caution are color coded	4	5	4	4	4	4	4.2
26	All machines guards are in proper position for safe machine operation	4	5	5	5	4	5	4.7
27	Squaring shears are equipped with finger guards	1	4	5	5	4	5	4.0
28	Squaring shears are equipped with foot treadle stops	1	5	5	4	4	5	4.0
29	Jointer knives are equipped with left and right guards	1	5	5	5	4	5	4.2
30	Abrasive wheels are equipped with safety eye shields	3	5	5	5	5	5	4.7
31	Abrasive wheels are equipped with tool rests	3	3	5	5	4	5	4.2
32	Abrasive wheels are equipped with guards	3	5	5	5	3	5	4.3
33	Table saws are equipped with guards and anti-kickback system	4	5	5	5	3	5	4.5
34	Radial saws are guarded and equipped with anti-kickback device	4	5	5	4	3	5	4.3
35	Radial saws are equipped with forward stop and positive saw return	4	5	5	4	3	5	4.3
36	Machine belts and pulleys are equipped with guards	3	5	5	5	3	5	4.3
37	Piped welding systems have back pressure valves in both lines	1		4	4	3	4	3.2
38	Piped welding systems have no quick opening shut off valves	1	5	4	4	3	4	3.5
39	Torches and regulators are in good operating condition	4	5	4	5	4	5	4.5
40	Hoses are maintained in good condition	4	4	4	4	4	5	4.2
41	Anti (fire) flashbacks are installed where required in all hoses and lines	4	4	5	5	3	5	4.3
42	Welding arcs cannot strike cylinders, gas or water lines	4	5	5	5	3	5	4.5
43	Electrode holders are maintained and stored in good condition	4	3	4	4	3	4	3.7
44	Proper ventilation is provided in welding areas	5	5	5	5	4	4	4.7

(Appendix E con'd)

N°	ITEMS	1	2	3	4	5	6	Avg
45	All hand-held power tools are equipped with a "dead man" switch	4	5	5	4	4	4	4.3
46	All electrical apparatus in areas of concentrated vapors are vapor proof	2	5	5	5	4	5	4.3
47	All hoisting devices are in safe operating condition	1	5	5	5	3	5	4.0
	SAFETY CONDITIONS							
48	Nonskid surfaces are provided around machines	3	4	4	4	3	4	3.7
49	All welding is done in screened areas	4	4	4	3	3	4	3.7
50	Cylinders are secured upright and stored in ventilated and clear areas	4	5	4	5	3	4	4.2
51	Danger zones are properly identified and guarded	4	5	4	4	3	5	4.2
52	Aisles are clear of protruding objects	4	3	3	5	4	3	3.7
53	Stairways have unobstructed access	2	3	3	5	4	4	3.5
54	Railings are color coded	2	3	3	3	2	3	2.7
55	Stairways are color coded	2	3	3	4	2	3	2.8
56	Electrical outlets and circuits are properly identified	3	4	5	4	2	4	3.7
57	Exits are adequately and properly identified	3	5	5	4	3	5	4.2
58	Walls are clear of hanging objects that might fall	2	4	3	5	3	4	3.5
59	Utility lines are properly located and identified	1	5	5	4	2	4	3.5
60	A master power switch panel controls all electrical outlets	3	5	4	5	3	5	4.2
61	Individual machine power switches are installed in power panels	3	5	5	4	3	5	4.2
62	Extension cords are in good condition (not spliced)	4	5	4	4	3	4	4.0
63	Extension cords have three-way grounded plugs	4	5	4	5	4	4	4.3
64	Cables are routed so that they are accessible for inspection and repair	2	4	3	4	3	3	3.2
65	All switches are enclosed	2		3	5	5	4	3.2
66	No temporary wiring is evident	2	4	3	4	3	4	3.3
67	The laboratory has eye wash bottles	4	4	5	4	4	5	4.3
68	The laboratory has chemical spill kits	4	5	5	4	3	3	4.0
69	The laboratory has safety showers	4	5	5	4	3	5	4.3
70	An adequately stocked first aid cabinet is provided	5	5	5	4	5	5	4.8
	HOUSEKEEPING							
71	Good housekeeping practices are evident	5	4	5	5	5	4	4.7
72	Benches are kept orderly	3	3	5	4	4	3	3.7
73	Corners and dead spots are clean and clear	1	3	4	4	3	3	3.0
74	Special tool racks are in orderly condition at bench and machine sites	2	3	3	3	4	3	3.0
75	Tools, supplies, and/or materials are orderly	3	4	3	4	5	3	3.7
76	Sufficient scrap boxes are provided	1	2	3	4	3	3	2.7
77	Materials are stored in an orderly and safe condition	4	4	3	4	4	4	3.8
	FIRE PROTECTION							
78	Sufficient fire extinguishers are available	4	5	5	5	3	4	4.3
79	Fire extinguishers are of the proper type	4	5	5	5	3	4	4.3
80	Fire extinguishers are adequately located, maintained and supplied	4	5	5	4	3	5	4.3
81	The laboratory has fire detectors	3	5	5	3	2	4	3.7
82	Spray room doors swing out and cannot be locked from the inside	1	5	5	5	2	4	3.7
83	Storage and waste containers are fire-proof	1	5	5	4	2	4	3.5
84	Wash tanks for parts that use solvents are fire proof	1	5	5	4	3	4	3.7
85	Fire proof storage cabinets are provided for all flammable liquids	1	5	5	5	2	5	3.8
	ERGONOMICS AND SAFETY ENGINEERING							
86	Room furniture and equipment are arranged to avoid accidents	3	4	4	5	3	3	3.7
87	Aisles are properly located for efficient performance	3	4	4	4	3	3	3.5
88	The tasks required from students are human factors compatible	1	3	4	4	2	3	2.8
89	Dials, controls and displays conform to human factors standards	1	4	3	4	2	3	2.3
90	There is local or direct lighting for equipment where needed	3	5	3	4	3	3	3.5
91	The work areas are free from direct or reflected glare sources	2	4	3	4	2	4	3.2
92	The work areas are free from evident sharp edges or trip hazards	2	5	4	5	3	5	4.0
93	The work areas are free from evident slip and fall hazards	3	5	4	5	3	5	4.2
94	Tool racks are available where needed	3	4	3	3	3	3	3.2

(Appendix E con'd)

N°	ITEMS	1	2	3	4	5	6	Avg
95	Areas for teaching and demonstration are available	2	3	3	4	2	3	2.8
96	Work stations are designed to prevent hazards from passing students	3	4	4	5	3	3	3.7
97	Work stations are designed to protect observing students from hazards	2	5	4	5	3	3	3.7
98	Safety instructions for use of each machine are posted or readily available	3	3	5	5	2	5	3.8
99	All machine switches are within easy reach of the operators	3	5	4	5	3	5	4.2
100	A visible "off" position is located on each machine	3	5	4	5	5	5	4.5
101	Machines are located in such way that operator space is adequate	3	4	3	5	3	4	3.7
102	Machines are located in such a way that required supervision is possible	3	4	3	4	3	5	3.7
103	Master and other power panels are easily accessible	2	5	3	5	3	5	3.8

QUESTIONNAIRE FOR TEACHERS

104	A safety policy or rules are enforced for safe shop operation	5	4	5	5	4	5	4.7
105	Number of laboratory groups are kept appropriate for the respective work stations	4	4	3	5	3	4	3.8
106	Laboratory areas are provided with custodial services	2	3	4	4	2	3	3.0
107	The school uses the services of a safety inspector or advisor	2	5	5	3	1	5	3.5
108	The school promotes and organizes safety contests	2	3	4	3	1	4	2.8
109	Emergency procedures have been established for emptying the facilities	4	5	4	5	2	5	4.2
110	All safety procedures are posted conspicuously near all areas of operation	3	4	4	5	2	4	3.7
111	The school has access to qualified individuals to administer first aid	3	5	4	5	3	5	4.2
112	Instructors are First Aid certified	2	5	4	4	3	5	3.8
113	The school has a policy and/or procedure for the administration of first aid	3	5	4	5	2	5	4.0
114	Routine preventative maintenance is practiced	4	3	5	5	3	4	4.0
115	All maintenance problems and requests for improvement are recorded	4	4	5	4	2	4	3.8
116	Facilities are inspected regularly for hazards and needed corrections	4	5	4	4	2	5	4.0
117	An inspection checklist is used when making the above inspections	2	5	4	4	2	5	3.7
118	All defective equipment and hazards are reported immediately	4	5	5	5	3	5	4.5
119	Records of all inspections are readily available for reference	2	3	4	3	1	5	3.0
120	Safety inspections of the shop are also made by a student safety committee	3	4	3	3	1	5	3.2
121	Students are rotated on the student safety committee	2	3	3	3	2	4	2.8
122	Lockers are inspected regularly for cleanliness and fire hazards	2	5	3	3	1	4	3.0
123	Locker doors are kept closed	2	5	3	3	2	4	3.2
124	One instructor has the overall responsibility for each major facility	3	5	3	5	3	5	4.0
125	Instructor supervision is provided at all times during laboratory sessions	5	5	4	5	5	5	4.8
126	All main power switches are " off " when laboratories are not in session	5	5	3	5	3	5	4.3
127	All machines are shut off when the instructor is out of the laboratory	4	5	3	5	5	5	4.5
128	All machines are shut off while unattended	5	5	4	5	4	5	4.7
129	All machines are off and tagged when being cleaned or adjusted	4	5	5	5	4		4.6
130	Continuous proper examples are practiced by the instructor	4	5	3	5	5	4	4.3
131	All accidents are reported for immediate attention and analysis	4	5	5	5	2	5	4.3
132	All accident analyses are used to implement prompt corrective measures	3	5	5	5	2	5	4.2
133	Activities are selected based on students' ability & maturation level	2	5	4	4	3	4	3.7
134	Machine operation instructions are posted or available near areas of operation	2	5	5	5	2	5	4.0
135	Tools are kept sharp, clean, and in safe working order	4	4	4	5	4	4	4.2
136	Materials being worked are secured when the operation so demands	4	5	4	5	4	4	4.3
137	All work undertaken is approved through an established method	3	4	4	5	3	3	3.7
138	Proper warnings are given in using toxics, caustics and volatile materials	2	5	5	5	3	5	4.2
139	The school promotes and develops the sense of safety consciousness	2	4	3	5	3	5	3.7
140	Questions on safety are included in the instructional program	3	5	3	5	2	5	3.8
141	Printed safety rules are given to each student	5	5	4	5	2		4.2
142	Motion and/or slide films on safety are used in the instruction	3	5	3	3	1	4	3.2
143	Occasional talks on safety are given by industry or outside specialists	3	5	3	3	1	4	3.2
144	Students that constantly violate safety regulations are removed from class	5	5	3	5	5	5	4.7
145	Dangerous horseplay and practical jokes are prohibited	5	5	4	5	5	5	4.8
146	A proper record is kept of safety instruction given	3	5	4	5	1	5	3.8
147	Inappropriate garments or other materials are kept out of activity areas	3	5	3	5	4	5	4.2
148	Safety bulletin boards and posters are part of the total safety program	3	5	4	3	1	4	3.3
149	Only spark lighters are used to light torches	3	5	4	4	3	4	3.8
150	Safety cans are provided for storing flammable liquids	2	5	5	5	3	5	4.2
151	Students are tested for safety knowledge	5	5	4	5	2	5	4.3
152	Students are tested for safety ability	5	5	4	5	2	5	4.3
153	Students are instructed in methods for handling and lifting materials	3	4	3	4	3	5	3.7

(Appendix E con'd)

N°	ITEMS	1	2	3	4	5	6	Avg
154	Students are instructed to clear off machines before turning them on	4	5	4	5	3	3	4.0
155	Students are instructed never to leave a machine while it is in operation	5	5	4	5	4	5	4.7
156	Students are instructed never to stop moving parts of a machine by hand	5	5	4	5	4	5	4.7
157	Students are instructed to stay clear of other operating machines	4	5	3	5	4	5	4.3
158	Students are instructed not to annoy or alarm an operator	5	5	4	5	5	5	4.8
159	Students are instructed in the use of the tools and equipment they operate	5	5	5	5	5	4	4.8
160	Students are tested and authorized before operating machines	5	5	5	5	4	5	4.8
161	Students are alerted and monitored for possible hazardous operations	5	5	5	5	4	5	4.8
162	Students are instructed as to how to report hazards and fires	4	5	4	4	3	5	4.2
163	Students sleeves are rolled above elbows when operating machines	3	5	3	5	2		3.6
164	Students avoid the use of loose clothing, jewelry, ties, long hair, etc.	5	5	3	5	4	5	4.5
165	The students are not exposed to unreasonable environmental changes	3	4	2	4	2	4	3.2
166	Noise from laboratory or other sources do not annoy or distract students	3	4	3	5	3	5	3.8
167	Scrap stock is promptly put in scrap boxes	2	4	3	5	4	4	3.7
168	Containers for oily rags are frequently emptied	2	4	4	5	3	4	3.7
169	Waste (shavings, sawdust, paint, etc.) is disposed of daily	4	4	4	4	1	3	3.3
170	Machines are kept in safe operating condition at all times	3	5	4	5	5	5	4.5
171	Temperature control for all seasons is adequate	2	4	2	4	2	3	2.8
172	Noise is always kept within accepiable levels at all laboratory locations	2	5	3	4	2	4	3.3
173	Proper tools and materials are always available for machine cleaning	2	4	3	5	4	5	3.8
174	All guards are used at all times	5		5	5	3	5	4.6
175	Signs are always secured to machines that are out of order	4	5	5	5	3		4.4
176	Power panel switches are always "off" when machines are out of order	4	5	3	5	4		4.2
177	Compressed air is always reduced to 30 psi when used for cleaning	2	5	3	5	2	5	3.7
178	Compressed air is always provided with proper tip when used for cleaning	2	5	3	5	2	5	3.7
179	Extension cords are always avoided as permanent installations	2	5	3	5	4	5	4.0
180	Arc welding is always done only in dry areas	4	5	4	5	4	5	4.5
181	Welding is always done only in areas free of combustible materials	4	5	5	5	4	5	4.7
182	Fire proof bulk storage is provided outside the facilities	2	5	5	5	4	4	4.2
183	All waste and oily rags are always placed in the correct containers	2	5	5	5	4	5	4.3
184	Noise levels never affect speech intelligibility or present a health hazard	2	5	3	1	3		2.8
185	There are not unusual human factors incompatibilities for working students	2	5	3	1	3	5	3.2
186	Reflective screens are always used as protection from arc flashes and burns	2	5	4	5	3	4	3.8
187	The laboratory keeps an inventory of all chemicals used	2	5	5	3	2	5	3.7
188	The laboratory uses materials safety handling sheets	2	5	5	4	2		3.6
189	The instructors are certified in handling chemicals	2	4	5	4	3	5	3.8
190	The instructor (s) has (have) 40 hour hazardous waste training	2	3	3	1	2	5	2.7
191	The laboratory is inspected for safety on a monthly basis	2	5	4	3	2	5	3.5
192	The laboratory has procedures for dealing with chemical spills	2	5	4	3	2	5	3.5
193	The laboratory has a planned response for chemical spills	2	5	4	3	2	5	3.5
194	Personal protective equipment is washed and disinfected as needed	3	5	4	5	4	5	4.3
195	Provisions are made for cleaning and disinfecting of respirators	2	5	4	5	4	5	4.2
196	Eye-wash baths and showers are available when using caustic materials	2	5	4	5	5	5	4.3
197	Eye-protective devices are disinfected & returned to proper racks after use	3	5	4	5	5	5	4.5
198	Observers use acceptable protection	3	5	3	5	4	4	4.0
199	Protective clothing (aprons, shoes, gloves, etc.) are used when required	5	5	4	5	4	5	4.7
200	Respiration and noise suppression devices are used as required	2	5	4	5	4	5	4.2
201	Eye protection devices are worn when required	5	5	5	5	5	5	5.0
202	Shields are provided for electric welding	5	5	4	5	5	5	4.8
203	Goggles with the proper lenses are used when torch welding	5	5	4	5	4	5	4.7
204	An arc-welding helmet with correct lenses is used when electric welding	5	5	4	5	5	5	4.8
205	Instructors are knowledgeable in the use of the fire extinguishers	5	5	4	4	4	5	4.5
206	Instructors know the procedures in the event of fire	4	5	4	5	4	5	4.5
207	Filters in spray booths are replaced regularly	1	5	4	5	2	3	3.3
208	Students know the location and use of the various fire extinguishers	4	5	5	5	3	5	4.5
209	Students are instructed on the basics of fire prevention	4	5	5	5	3	5	4.5
210	Students are instructed as to how to report fires	4	5	4	5	2	5	4.2

APPENDIX F
ITEMIZED SAFEY NEED INDEXES

LOWER QUARTILE

Item	SNI
Squaring shears are equipped with foot treadle stops	N/A
Squaring shears are equipped with finger guards	N/A
Piped welding systems have no quick opening shut off valves	8.7%
Stairways are color coded	10.0%
Railings are color coded	10.3%
The laboratory has chemical spill kits	10.6%
The laboratory has safety showers	10.7%
Nonskid surfaces are provided around machines	16.8%
Students are rotated on the student safety committee	18.7%
Fire proof storage cabinets are provided for all flammable liquids	18.9%
The laboratory has eye wash bottles	19.3%
Storage and waste containers are fire-proof	21.3%
Safety inspections of the shop are also made by a student safety committee	22.3%
The laboratory has procedures for dealing with chemical spills	23.2%
The instructor (s) has (have) 40 hour hazardous waste training	23.6%
Eye-wash baths and showers are available when using caustic materials	24.2%
The laboratory has a planned response for chemical spills	24.2%
Laboratory areas are provided with custodial services	26.6%
Parts of machines needing special caution are color coded	26.8%
Fire proof bulk storage is provided outside the facilities	27.2%
Instructors are First Aid certified	27.7%
The school promotes and organizes safety contests	28.4%
An adequately stocked first aid cabinet is provided	29.7%
Spray room doors swing out and cannot be locked from the inside	30.5%
The laboratory uses materials safety handling sheets	30.5%
The laboratory keeps an inventory of all chemicals used	30.8%
All main power switches are " off " when laboratories are not in session	32.0%
The laboratory is inspected for safety on a monthly basis	33.9%
Machine operation instructions are posted or available near areas of operation	34.8%
Provisions are made for cleaning and disinfecting of respirators	34.8%
Danger zones are properly identified and guarded	34.9%
Signs are always secured to machines that are out of order	35.2%
Respiration and noise suppression devices are used as required	35.9%
Wash tanks for parts that use solvents are fire proof	36.0%
The area or square feet of laboratory per student is adequate	36.5%
The school uses the services of a safety inspector or advisor	37.8%
Safety instructions for use of each machine are posted or readily available	38.0%
The laboratory has fire detectors	38.2%
Safety cans are provided for storing flammable liquids	38.4%
Eye-protective devices are disinfected & returned to proper racks after use	38.7%
An inspection checklist is used when making the above inspections	39.8%
All safety procedures are posted conspicuously near all areas of operation	40.1%
All hand-held power tools are equipped with a "dead man" switch	40.5%
The instructors are certified in handling chemicals	40.6%
All guards are used at all times	41.2%
Table saws are equipped with guards and anti-kickback system	41.4%
All electrical apparatus in areas of concentrated vapors are vapor proof	41.8%
All stationary machines are securely fastened in place	42.6%
Proper ventilation is provided in welding areas	43.2%
Good housekeeping practices are evident	43.6%
All welding is done in screened areas	44.2%
All waste and oily rags are always placed in the correct containers	45.0%
Exits are adequately and properly identified	45.5%

(Appendix F con't)

SNI = Safey need index

SECOND QUARTILE

#	Item	SNI
30	Abrasive wheels are equipped with safety eye shields	46.1%
115	All maintenance problems and requests for improvement are recorded	46.5%
26	All machines guards are in proper position for safe machine operation	46.6%
173	Proper tools and materials are always available for machine cleaning	47.5%
17	Air is free from dust, smoke, or other contaminants	48.0%
16	Ventilation is adequate and proper for conditions	48.1%
119	Records of all inspections are readily available for reference	48.3%
41	Anti (fire) flashbacks are installed where required in all hoses and lines	48.6%
35	Radial saws are equipped with forward stop and positive saw return	48.8%
8	Stairways have safe treads and risers	50.1%
144	Students that constantly violate safety regulations are removed from class	50.9%
29	Jointer knives are equipped with left and right guards	51.1%
7	Storage space for equipment and materials being worked on is adequate	51.2%
186	Reflective screens are always used as protection from arc flashes and burns	51.4%
129	All machines are off and tagged when being cleaned or adjusted	51.6%
56	Electrical outlets and circuits are properly identified	52.2%
148	Safety bulletin boards and posters are part of the total safety program	52.4%
194	Personal protective equipment is washed and disinfected as needed	52.6%
166	Noise from laboratory or other sources do not annoy or distract students	52.8%
105	Number of laboratory groups are kept appropriate for the respective work stations	54.6%
177	Compressed air is always reduced to 30 psi when used for cleaning	55.0%
47	All hoisting devices are in safe operating condition	55.4%
163	Students sleeves are rolled above elbows when operating machines	55.7%
201	Eye protection devices are worn when required	56.8%
34	Radial saws are guarded and equipped with anti-kickback device	57.0%
1	General appearance is conducive to student safety	57.1%
145	Dangerous horseplay and practical jokes are prohibited	57.4%
176	Power panel switches are always "off" when machines are out of order	57.5%
167	Scrap stock is promptly put in scrap boxes	57.5%
143	Occasional talks on safety are given by industry or outside specialists	57.6%
6	Storage space for tools and materials is adequate	57.6%
59	Utility lines are properly located and identified	57.8%
23	Work stations are designed to prevent hazards from fire or fumes	58.1%
111	The school has access to qualified individuals to administer first aid	58.3%
207	Filters in spray booths are replaced regularly	58.4%
93	The work areas are free from evident slip and fall hazards	58.5%
36	Machine belts and pulleys are equipped with guards	58.6%
160	Students are tested and authorized before operating machines	58.7%
125	Instructor supervision is provided at all times during laboratory sessions	58.7%
13	Facilities are clean and orderly	58.8%
127	All machines are shut off when the instructor is out of the laboratory	59.2%
24	Work stations are designed to prevent hazards from other machines	59.3%
118	All defective equipment and hazards are reported immediately	59.3%
208	Students know the location and use of the various fire extinguishers	59.3%
73	Corners and dead spots are clean and clear	59.7%
122	Lockers are inspected regularly for cleanliness and fire hazards	60.0%
159	Students are instructed in the use of the tools and equipment they operate	60.0%
161	Students are alerted and monitored for possible hazardous operations	60.0%
158	Students are instructed not to annoy or alarm an operator	60.1%
202	Shields are provided for electric welding	60.1%
60	A master power switch panel controls all electrical outlets	60.4%
50	Cylinders are secured upright and stored in ventilated and clear areas	60.4%
170	Machines are kept in safe operating condition at all times	60.7%

(Appendix F con't)

SNI = Safey need index

THIRD QUARTILE

#	Item	SNI
42	Welding arcs cannot strike cylinders, gas or water lines	61.4%
184	Noise levels never affect speech intelligibility or present a health hazard	61.6%
204	An arc-welding helmet with correct lenses is used when electric welding	61.7%
75	Tools, supplies, and/or materials are orderly	61.8%
181	Welding is always done only in areas free of combustible materials	61.9%
128	All machines are shut off while unattended	61.9%
199	Protective clothing (aprons, shoes, gloves, etc.) are used when required	61.9%
169	Waste (shavings, sawdust, paint, etc.) is disposed of daily	62.2%
77	Materials are stored in an orderly and safe condition	62.2%
2	Floors are kept in a condition conducive to student safety	62.3%
32	Abrasive wheels are equipped with guards	62.3%
72	Benches are kept orderly	62.5%
171	Temperature control for all seasons is adequate	62.6%
116	Facilities are inspected regularly for hazards and needed corrections	62.7%
124	One instructor has the overall responsibility for each major facility	63.0%
104	A safety policy or rules are enforced for safe shop operation	63.3%
132	All accident analyses are used to implement prompt corrective measures	63.3%
155	Students are instructed never to leave a machine while it is in operation	63.3%
156	Students are instructed never to stop moving parts of a machine by hand	63.3%
203	Goggles with the proper lenses are used when torch welding	63.4%
31	Abrasive wheels are equipped with tool rests	63.4%
80	Fire extinguishers are adequately located, maintained and supplied	63.4%
164	Students avoid the use of loose clothing, jewelry, ties, long hair, etc.	63.6%
39	Torches and regulators are in good operating condition	63.9%
61	Individual machine power switches are installed in power panels	64.2%
172	Noise is always kept within acceptable levels at all laboratory locations	64.2%
100	A visible "off" position is located on each machine	64.3%
78	Sufficient fire extinguishers are available	64.3%
113	The school has a policy and/or procedure for the administration of first aid	64.4%
168	Containers for oily rags are frequently emptied	64.4%
141	Printed safety rules are given to each student	64.5%
15	Illumination is sufficient and non glare lighting is provided for all work areas	65.0%
22	Work stations are designed to prevent hazards from excess heat or noise	65.1%
209	Students are instructed on the basics of fire prevention	65.2%
152	Students are tested for safety ability	65.3%
92	The work areas are free from evident sharp edges or trip hazards	65.5%
103	Master and other power panels are easily accessible	65.6%
86	Room furniture and equipment are arranged to avoid accidents	65.7%
63	Extension cords have three-way grounded plugs	65.7%
146	A proper record is kept of safety instruction given	65.8%
94	Tool racks are available where needed	65.8%
138	Proper warnings are given in using toxics, caustics and volatile materials	65.9%
205	Instructors are knowledgeable in the use of the fire extinguishers	66.6%
206	Instructors know the procedures in the event of fire	66.6%
180	Arc welding is always done only in dry areas	66.6%
96	Work stations are designed to prevent hazards from passing students	67.1%
52	Aisles are clear of protruding objects	67.2%
62	Extension cords are in good condition (not spliced)	67.6%
179	Extension cords are always avoided as permanent installations	67.9%
79	Fire extinguishers are of the proper type	68.0%
210	Students are instructed as to how to report fires	68.4%
76	Sufficient scrap boxes are provided	68.6%
5	There are sufficient exits in each laboratory	68.9%

(Appendix F con't)

SNI = Safey need index

UPPER QUARTILE

#	Item	SNI
101	Machines are located in such way that operator space is adequate	69.0%
18	General arrangement conforms to good safety practices	69.3%
162	Students are instructed as to how to report hazards and fires	69.9%
136	Materials being worked are secured when the operation so demands	69.9%
131	All accidents are reported for immediate attention and analysis	69.9%
151	Students are tested for safety knowledge	69.9%
130	Continuous proper examples are practiced by the instructor	69.9%
157	Students are instructed to stay clear of other operating machines	69.9%
147	Inappropriate garments or other materials are kept out of activity areas	70.0%
135	Tools are kept sharp, clean, and in safe working order	70.0%
153	Students are instructed in methods for handling and lifting materials	70.3%
97	Work stations are designed to protect observing students from hazards	70.4%
40	Hoses are maintained in good condition	70.6%
99	All machine switches are within easy reach of the operators	71.0%
74	Special tool racks are in orderly condition at bench and machine sites	71.1%
198	Observers use acceptable protection	71.3%
10	Mezzanines are protected with toe boards or railings	71.5%
12	Facilities are pleasant & conducive to student safety	72.2%
87	Aisles are properly located for efficient performance	72.3%
178	Compressed air is always provided with proper tip when used for cleaning	72.3%
43	Electrode holders are maintained and stored in good condition	72.9%
114	Routine preventative maintenance is practiced	73.1%
109	Emergency procedures have been established for emptying the facilities	73.2%
90	There is local or direct lighting for equipment where needed	73.7%
58	Walls are clear of hanging objects that might fall	74.1%
11	The facilities are wheelchair accessible (including laboratories)	74.6%
154	Students are instructed to clear off machines before turning them on	74.7%
137	All work undertaken is approved through an established method	75.5%
102	Machines are located in such a way that required supervision is possible	75.6%
123	Locker doors are kept closed	75.6%
139	The school promotes and develops the sense of safety consciousness	75.8%
185	There are not unusual human factors incompatibilities for working students	77.0%
9	Stairways have approved railings	77.3%
149	Only spark lighters are used to light torches	77.9%
21	Auxiliary equipment is orderly and readily available	78.7%
140	Questions on safety are included in the instructional program	79.8%
20	Machines are located for required process compatibility	81.0%
3	Walls and ceilings are kept in a condition conducive to student safety	81.4%
53	Stairways have unobstructed access	81.6%
133	Activities are selected based on students' ability & maturation level	83.1%
91	The work areas are free from direct or reflected glare sources	84.0%
66	No temporary wiring is evident	84.6%
142	Motion and/or slide films on safety are used in the instruction	84.7%
4	The facilities are free from evident architectural barriers	85.8%
65	All switches are enclosed	86.5%
165	The students are not exposed to unreasonable environmental changes	86.8%
64	Cables are routed so that they are accessible for inspection and repair	87.9%
95	Areas for teaching and demonstration are available	90.5%
37	Piped welding systems have back pressure valves in both lines	92.6%
88	The tasks required from students are human factors compatible	93.6%
89	Dials, controls and displays conform to human factors standards	100.0%

SNI = Safey need index

APPENDIX G
RELATIONSHIP BETWEEN FSR's & SNI's

N°	ITEMS	N/A'S	FSR	RSIF	SNI%
	BUILDING				
1	General appearance is conducive to student safety	0	7.2	3.83	57.1%
2	Floors are kept in a condition conducive to student safety	0	8.5	4.17	62.3%
3	Walls and ceilings are kept in a condition conducive to student safety	0	6.4	3.00	81.4%
4	The facilities are free from evident architectural barriers	0	6.9	3.00	85.8%
5	There are sufficient exits in each laboratory	0	9.4	4.17	68.9%
6	Storage space for tools and materials is adequate	0	7.3	3.83	57.6%
7	Storage space for equipment and materials being worked on is adequate	0	6.5	3.80	51.2%
8	Stairways have safe treads and risers	34	5.6	3.33	50.1%
9	Stairways have approved railings	34	8.0	3.00	77.3%
10	Mezzanines are protected with toe boards or railings	35	7.7	3.17	71.5%
11	The facilities are wheelchair accessible (including laboratories)	1	6.7	2.33	74.6%
	ENVIRONMENT				
12	Facilities are pleasant & conducive to student safety	0	8.1	3.33	72.2%
13	Facilities are clean and orderly	0	7.4	3.83	58.8%
14	The area or square feet of laboratory per student is adequate	0	4.4	3.50	36.5%
15	Illumination is sufficient and non glare lighting is provided for all work areas	0	8.2	3.83	65.0%
16	Ventilation is adequate and proper for conditions	0	7.2	4.50	48.1%
17	Air is free from dust, smoke, or other contaminants	0	6.3	4.00	48.0%
	MACHINES & EQUIPMENT				
18	General arrangement conforms to good safety practices	1	8.1	3.50	69.3%
19	All stationary machines are securely fastened in place	8	4.5	3.17	42.6%
20	Machines are located for required process compatibility	1	8.2	2.83	81.0%
21	Auxiliary equipment is orderly and readily available	2	7.9	2.83	78.7%
22	Work stations are designed to prevent hazards from excess heat or noise	2	7.8	3.67	65.1%
23	Work stations are designed to prevent hazards from fire or fumes	3	8.0	4.17	58.1%
24	Work stations are designed to prevent hazards from other machines	2	8.2	4.17	59.3%
25	Parts of machines needing special caution are color coded	4	3.5	4.17	26.6%
26	All machines guards are in proper position for safe machine operation	2	7.3	4.67	46.6%
27	Squaring shears are equipped with finger guards	41	0		0.0%
28	Squaring shears are equipped with foot treadle stops	41	0		0.0%
29	Jointer knives are equipped with left and right guards	35	6.1	4.17	51.1%
30	Abrasive wheels are equipped with safety eye shields	9	6.9	4.67	46.1%
31	Abrasive wheels are equipped with tool rests	9	8.3	4.17	63.4%
32	Abrasive wheels are equipped with guards	9	8.5	4.33	62.3%
33	Table saws are equipped with guards and anti-kickback system	13	6.1	4.50	41.4%
34	Radial saws are guarded and equipped with anti-kickback device	18	8.5	4.33	57.0%
35	Radial saws are equipped with forward stop and positive saw return	19	7.3	4.33	48.8%
36	Machine belts and pulleys are equipped with guards	11	8.3	4.33	58.6%
37	Piped welding systems have back pressure valves in both lines	40	5.1	3.20	92.6%
38	Piped welding systems have no quick opening shut off valves	40	0.5	3.50	8.7%
39	Torches and regulators are in good operating condition	3	9.5	4.50	63.9%
40	Hoses are maintained in good condition	2	9.6	4.17	70.6%
41	Anti (fire) flashbacks are installed where required in all hoses and lines	6	7.1	4.33	48.6%
42	Welding arcs cannot strike cylinders, gas or water lines	2	9.2	4.50	61.4%
43	Electrode holders are maintained and stored in good condition	4	8.8	3.67	72.9%
44	Proper ventilation is provided in welding areas	2	6.8	4.67	43.2%
45	All hand-held power tools are equipped with a "dead man" switch	4	5.5	4.33	40.5%
46	All electrical apparatus in areas of concentrated vapors are vapor proof	38	4.9	4.33	41.8%
47	All hoisting devices are in safe operating condition	33	6.6	4.00	55.4%

(Appendix G con'd)

N/A's=Non applicables-FSR=Field safety ratings RSIF=Relative safety importance factor-SNI%=Safety need index (%)

SAFETY CONDITIONS

48	Nonskid surfaces are provided around machines	3	2.0	3.67	16.8%
49	All welding is done in screened areas	3	5.3	3.67	44.2%
50	Cylinders are secured upright and stored in ventilated and clear areas	2	8.3	4.17	60.4%
51	Danger zones are properly identified and guarded	2	4.8	4.17	34.9%
52	Aisles are clear of protruding objects	0	8.1	3.67	67.2%
53	Stairways have unobstructed access	34	8.5	3.50	81.6%
54	Railings are color coded	34	0.9	2.67	10.3%
55	Stairways are color coded	35	0.9	2.83	10.0%
56	Electrical outlets and circuits are properly identified	0	6.1	3.67	52.2%
57	Exits are adequately and properly identified	0	6.4	4.17	45.5%
58	Walls are clear of hanging objects that might fall	0	8.6	3.50	74.1%
59	Utility lines are properly located and identified	7	6.9	3.50	57.8%
60	A master power switch panel controls all electrical outlets	0	8.2	4.17	60.4%
61	Individual machine power switches are installed in power panels	2	8.8	4.17	64.2%
62	Extension cords are in good condition (not spliced)	3	9.1	4.00	67.6%
63	Extension cords have three-way grounded plugs	3	9.4	4.33	65.7%
64	Cables are routed so that they are accessible for inspection and repair	12	9.4	3.17	87.9%
65	All switches are enclosed	0	9.3	3.17	86.5%
66	No temporary wiring is evident	0	9.4	3.33	84.6%
67	The laboratory has eye wash bottles	2	2.8	4.33	19.3%
68	The laboratory has chemical spill kits	5	1.4	4.00	10.6%
69	The laboratory has safety showers	3	1.5	4.33	10.7%
70	An adequately stocked first aid cabinet is provided	1	4.7	4.83	29.7%

HOUSEKEEPING

71	Good housekeeping practices are evident	0	6.9	4.67	43.6%
72	Benches are kept orderly	5	7.6	3.67	62.5%
73	Corners and dead spots are clean and clear	0	6.3	3.00	59.7%
74	Special tool racks are in orderly condition at bench and machine sites	13	7.3	3.00	71.1%
75	Tools, supplies, and/or materials are orderly	0	7.5	3.67	61.8%
76	Sufficient scrap boxes are provided	2	6.6	2.67	68.6%
77	Materials are stored in an orderly and safe condition	1	7.9	3.83	62.2%

FIRE PROTECTION

78	Sufficient fire extinguishers are available	0	9.0	4.33	64.3%
79	Fire extinguishers are of the proper type	1	9.5	4.33	68.0%
80	Fire extinguishers are adequately located, maintained and supplied	1	8.9	4.33	63.4%
81	The laboratory has fire detectors	1	4.8	3.67	38.2%
82	Spray room doors swing out and cannot be locked from the inside	38	5.4	3.67	30.5%
83	Storage and waste containers are fire-proof	4	2.5	3.50	21.3%
84	Wash tanks for parts that use solvents are fire proof	28	4.2	3.67	36.0%
85	Fire proof storage cabinets are provided for all flammable liquids	9	2.4	3.83	18.9%

ERGONOMICS AND SAFETY ENGINEERING

86	Room furniture and equipment are arranged to avoid accidents	0	8.0	3.67	65.7%
87	Aisles are properly located for efficient performance	1	8.4	3.50	72.3%
88	The tasks required from students are human factors compatible	0	9.4	2.83	93.6%
89	Dials, controls and displays conform to human factors standards	2	9.1	2.33	100.0%
90	There is local or direct lighting for equipment where needed	4	8.5	3.50	73.7%
91	The work areas are free from direct or reflected glare sources	0	9.0	3.17	84.0%
92	The work areas are free from evident sharp edges or trip hazards	0	8.6	4.00	65.5%
93	The work areas are free from evident slip and fall hazards	0	8.1	4.17	58.5%
94	Tool racks are available where needed	8	7.0	3.17	65.8%
95	Areas for teaching and demonstration are available	0	9.2	2.83	90.5%
96	Work stations are designed to prevent hazards from passing students	0	8.1	3.67	67.1%
97	Work stations are designed to protect observing students from hazards	1	8.5	3.67	70.4%

(Appendix G con'd)

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98	Safety instructions for use of each machine are posted or readily available	3	5.0	3.83	38.0%
99	All machine switches are within easy reach of the operators	2	9.7	4.17	71.0%
100	A visible "off" position is located on each machine	2	9.6	4.50	64.3%
101	Machines are located in such way that operator space is adequate	2	8.3	3.67	69.0%
102	Machines are located in such a way that required supervision is possible	2	9.1	3.67	75.6%
103	Master and other power panels are easily accessible	1	8.2	3.83	65.6%

QUESTIONNAIRE FOR TEACHERS

104	A safety policy or rules are enforced for safe shop operation	0	10.0	4.67	63.3%
105	Number of laboratory groups are kept appropriate for the respective work stations	1	6.6	3.83	54.6%
106	Laboratory areas are provided with custodial services	0	2.6	3.00	26.6%
107	The school uses the services of a safety inspector or advisor	1	4.4	3.50	37.8%
108	The school promotes and organizes safety contests	2	3.1	2.83	26.4%
109	Emergency procedures have been established for emptying the facilities	0	9.8	4.17	73.2%
110	All safety procedures are posted conspicuously near all areas of operation	1	4.8	3.67	40.1%
111	The school has access to qualified individuals to administer first aid	1	8.0	4.17	58.3%
112	Instructors are First Aid certified	1	3.5	3.83	27.7%
113	The school has a policy and/or procedure for the administration of first aid	1	8.6	4.00	64.4%
114	Routine preventative maintenance is practiced	0	9.6	4.00	73.1%
115	All maintenance problems and requests for improvement are recorded	0	5.8	3.83	46.5%
116	Facilities are inspected regularly for hazards and needed corrections	1	8.2	4.00	62.7%
117	An inspection checklist is used when making the above inspections	3	5.0	3.67	39.8%
118	All defective equipment and hazards are reported immediately	0	8.9	4.50	59.3%
119	Records of all inspections are readily available for reference	5	5.0	3.00	48.3%
120	Safety inspections of the shop are also made by a student safety committee	3	2.4	3.17	22.3%
121	Students are rotated on the student safety committee	11	1.9	2.83	18.7%
122	Lockers are inspected regularly for cleanliness and fire hazards	22	6.0	3.00	60.0%
123	Locker doors are kept closed	22	7.9	3.17	75.6%
124	One instructor has the overall responsibility for each major facility	0	8.5	4.00	63.0%
125	Instructor supervision is provided at all times during laboratory sessions	0	9.8	4.83	58.7%
126	All main power switches are " off " when laboratories are not in session	3	4.5	4.33	32.0%
127	All machines are shut off when the instructor is out of the laboratory	1	8.9	4.50	59.2%
128	All machines are shut off while unattended	1	9.8	4.67	61.9%
129	All machines are off and tagged when being cleaned or adjusted	1	8.0	4.60	51.6%
130	Continuous proper examples are practiced by the instructor	0	10.0	4.33	69.9%
131	All accidents are reported for immediate attention and analysis	0	10.0	4.33	69.9%
132	All accident analyses are used to implement prompt corrective measures	1	8.6	4.17	63.3%
133	Activities are selected based on students' ability & maturation level	0	10.0	3.67	83.1%
134	Machine operation instructions are posted or available near areas of operation	3	4.8	4.00	34.8%
135	Tools are kept sharp, clean, and in safe working order	0	9.3	4.17	70.0%
136	Materials being worked are secured when the operation so demands	0	10.0	4.33	69.9%
137	All work undertaken is approved through an established method	1	9.3	3.67	75.5%
138	Proper warnings are given in using toxics, caustics and volatile materials	6	8.7	4.17	65.9%
139	The school promotes and develops the sense of safety consciousness	0	9.1	3.67	75.8%
140	Questions on safety are included in the instructional program	0	10.0	3.83	79.8%
141	Printed safety rules are given to each student	0	9.1	4.20	64.5%
142	Motion and/or slide films on safety are used in the instruction	0	9.1	3.17	84.7%
143	Occasional talks on safety are given by industry or outside specialists	1	6.2	3.17	57.6%
144	Students that constantly violate safety regulations are removed from class	0	8.0	4.67	50.9%
145	Dangerous horseplay and practical jokes are prohibited	0	9.6	4.83	57.4%
146	A proper record is kept of safety instruction given	0	8.2	3.83	65.8%
147	Inappropriate garments or other materials are kept out of activity areas	0	9.6	4.17	70.0%
148	Safety bulletin boards and posters are part of the total safety program	0	6.0	3.33	52.4%
149	Only spark lighters are used to light torches	2	9.8	3.83	77.9%
150	Safety cans are provided for storing flammable liquids	9	5.2	4.17	38.4%
151	Students are tested for safety knowledge	0	10.0	4.33	69.9%
152	Students are tested for safety ability	0	9.3	4.33	65.3%
153	Students are instructed in methods for handling and lifting materials	0	8.5	3.67	70.3%
154	Students are instructed to clear off machines before turning them on	3	9.7	4.00	74.7%

(Appendix G con'd)

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155	Students are instructed never to leave a machine while it is in operation	1	10.0	4.67	63.3%
156	Students are instructed never to stop moving parts of a machine by hand	1	10.0	4.67	63.3%
157	Students are instructed to stay clear of other operating machines	1	10.0	4.33	69.9%
158	Students are instructed not to annoy or alarm an operator	1	10.0	4.83	60.1%
159	Students are instructed in the use of the tools and equipment they operate	0	10.0	4.83	60.0%
160	Students are tested and authorized before operating machines	0	9.8	4.83	58.7%
161	Students are alerted and monitored for possible hazardous operations	0	10.0	4.83	60.0%
162	Students are instructed as to how to report hazards and fires	0	9.8	4.17	69.9%
163	Students sleeves are rolled above elbows when operating machines	4	6.8	3.60	55.7%
164	Students avoid the use of loose clothing, jewelry, ties, long hair, etc.	1	9.5	4.50	63.6%
165	The students are not exposed to unreasonable environmental changes	0	9.3	3.17	86.8%
166	Noise from laboratory or other sources do not annoy or distract students	1	6.4	3.83	52.8%
167	Scrap stock is promptly put in scrap boxes	3	6.9	3.67	57.5%
168	Containers for oily rags are frequently emptied	9	8.0	3.67	64.4%
169	Waste (shavings, sawdust, paint, etc.) is disposed of daily	3	6.9	3.33	62.2%
170	Machines are kept in safe operating condition at all times	1	9.1	4.50	60.7%
171	Temperature control for all seasons is adequate	0	6.3	2.83	62.6%
172	Noise is always kept within acceptable levels at all laboratory locations	0	7.4	3.33	64.2%
173	Proper tools and materials are always available for machine cleaning	1	5.9	3.83	47.5%
174	All guards are used at all times	1	6.4	4.60	41.2%
175	Signs are always secured to machines that are out of order	2	5.1	4.40	35.2%
176	Power panel switches are always "off" when machines are out of order	2	7.9	4.20	57.5%
177	Compressed air is always reduced to 30 psi when used for cleaning	20	6.4	3.67	55.0%
178	Compressed air is always provided with proper tip when used for cleaning	21	8.4	3.67	72.3%
179	Extension cords are always avoided as permanent installations	1	8.9	4.00	67.9%
180	Arc welding is always done only in dry areas	3	10.0	4.50	66.6%
181	Welding is always done only in areas free of combustible materials	3	9.7	4.67	61.9%
182	Fire proof bulk storage is provided outside the facilities	8	3.7	4.17	27.2%
183	All waste and oily rags are always placed in the correct containers	8	6.7	4.33	45.0%
184	Noise levels never affect speech intelligibility or present a health hazard	1	5.9	2.80	61.6%
185	There are not unusual human factors incompatibilities for working students	4	8.3	3.17	77.0%
186	Reflective screens are always used as protection from arc flashes and burns	3	6.2	3.83	51.4%
187	The laboratory keeps an inventory of all chemicals used	11	3.7	3.67	30.8%
188	The laboratory uses materials safety handling sheets	10	3.9	3.60	30.5%
189	The instructors are certified in handling chemicals	8	5.3	3.83	40.6%
190	The instructor (s) has (have) 40 hour hazardous waste training	6	2.3	2.67	23.6%
191	The laboratory is inspected for safety on a monthly basis	1	3.9	3.50	33.9%
192	The laboratory has procedures for dealing with chemical spills	9	2.7	3.50	23.2%
193	The laboratory has a planned response for chemical spills	11	2.8	3.50	24.2%
194	Personal protective equipment is washed and disinfected as needed	8	7.8	4.33	52.6%
195	Provisions are made for cleaning and disinfecting of respirators	24	4.6	4.17	34.8%
196	Eye-wash baths and showers are available when using caustic materials	15	3.4	4.33	24.2%
197	Eye-protective devices are disinfected & returned to proper racks after use	11	5.7	4.50	38.7%
198	Observers use acceptable protection	3	9.0	4.00	71.3%
199	Protective clothing (aprons, shoes, gloves, etc.) are used when required	1	9.8	4.67	61.9%
200	Respiration and noise suppression devices are used as required	13	4.5	4.17	35.9%
201	Eye protection devices are worn when required	0	10.0	5.00	56.8%
202	Shields are provided for electric welding	3	10.0	4.83	60.1%
203	Goggles with the proper lenses are used when torch welding	3	10.0	4.67	63.4%
204	An arc-welding helmet with correct lenses is used when electric welding	4	10.0	4.83	61.7%
205	Instructors are knowledgeable in the use of the fire extinguishers	0	10.0	4.50	66.6%
206	Instructors know the procedures in the event of fire	0	10.0	4.50	66.6%
207	Filters in spray booths are replaced regularly	33	6.0	3.33	58.4%
208	Students know the location and use of the various fire extinguishers	0	8.7	4.50	59.3%
209	Students are instructed on the basics of fire prevention	0	9.8	4.50	65.2%
210	Students are instructed as to how to report fires	0	9.3	4.17	68.4%

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VITA

Julio A. Meléndez M. eldest of two children, born to Julio A. Meléndez L. and Leticia M. de Meléndez, in La Chorrera, Republic of Panamá. Married to Edna May Rubio de Meléndez for 28 years. They have three children, María Leticia, Julio Martín, and José Joaquín, the three of them attending universities.

Julio, raised in Panama City, nurtured by his parents and a large family, displayed a love for study, social work and entrepreneurship since early age. After graduating from La Salle High School at age 16, started undergraduate studies at the University of Illinois, Champaign, Urbana, IL. where he completed his freshman year. Being granted a scholarship from SICAP, transferred to Louisiana State University, where he obtained a B.S. Degree in Agricultural Engineering, 1957, specializing in soil and water conservation. Julio returned to his home country working for Panamá's Government as head of the Agricultural Engineering department. During this period attended many international conferences. Was elected President of the Second Latin American Irrigation Conference, held in Panama City. Sponsored by the USAID program enrolled the University of California, Berkeley where he obtained a M.S. Degree in Civil Engineering, 1963, specializing in Hydrology. Returned to Panamá and continued to work with Panamá's Government.

He was the principal writer of Panamá's Water Code that was later approved by the Legislature after which was appointed Chief Executive of the

National Water Commission, and at the same time held the position of Director for the La Villa River Irrigation Project under the United Nations sponsorship.

Since 1968 engaged in banking activities related to industrial projects, holding the position of National Director of Industrial Projects for the National Bank of Panamá. For six years taught Agricultural Engineering in the University of Panamá as an Associate Profesor. In 1971 went into private practice engaging in land and Real Estate development.

In 1988 emigrated to the United States with his family, while remaining involved in private business in Panamá. His desire to increase knowledge, lead him to become certified in Real Estate, Mortgage Banking and Insurance in the state of Florida. In 1991 decided to work on a PH.D. in engineering, enrolling again in his alma matter LSU, fulfilling a long time desire.

Through his life time Julio remained involved in many professional and civic organizations in the Republic of Panamá and the United States. A Rotarian since 1979, was President and charter member of the Rotary Club of La Chorrera, member of Panamá Central Rotary Club, and currently belongs to the Rotary Club of Miami West. As a member of the Panamanian Society of Engineers and Architects, twice held the position of Director of the Industrial Engineers Division. Was President of the Agronomical Society of Panamá. He is former member of ASAE, and ASCE. He is Certified as Agricultural Engineer, and Civil Engineer in the Republic of Panamá.

DOCTORAL EXAMINATION AND DISSERTATION REPORT

Candidate: Julio A. Melendez

Major Field: Engineering Science

Title of Dissertation: A Methodology to Assess Safety Conditions in Louisiana Agriscience Laboratories

Approved:

Richard L Bowyer
Major Professor and Chairman

James M Larkin
Dean of the Graduate School

EXAMINING COMMITTEE:

Hoyhzaden
Co-Chairman

Frederick E Sistler

Joe Kotrlik

Ralph Martin

Date of Examination:

December 14, 1995